

# Appendix C

## Chemical Properties Data

Chemical Summary for . . .

**1,3-BENZENEDIOL**

**1 H-PYRROLE**

**2-BUTOXYETHANOL ACETATE**

**2-ETHOXYETHANOL**

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**BORIC ACID**

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**COPPER AND SELECTED COPPER COMPOUNDS**

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**ETHANOLAMINE**

**ETHYLENE GLYCOL**

**ETHYLENEDIAMINE TETRAACETIC ACID (EDTA)**

**FLUOROBORIC ACID (FLUORIDE)**

**FORMALDEHYDE**

**FORMIC ACID**

**GRAPHITE**

**HYDROCHLORIC ACID**

**HYDROGEN PEROXIDE**  
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**ISOPHORONE**  
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**LITHIUM HYDROXIDE**  
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**MAGNESIUM CARBONATE**  
**METHANOL**  
***p*-TOLUENE SULFONIC ACID**  
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**POTASSIUM SULFATE**  
**POTASSIUM SODIUM TARTRATE**  
**SILVER**  
**SODIUM BISULFATE**  
**SODIUM CARBONATE**  
**SODIUM CHLORIDE**  
**SODIUM CHLORITE**  
**SODIUM HYDROXIDE**  
**SODIUM HYPOPHOSPHITE**  
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**TARTARIC ACID**

**TETRASODIUM EDTA (Na<sub>4</sub>EDTA)**

**TRIETHANOLAMINE**

**SODIUM CITRATE**

**VANILLIN**

**CITED REFERENCES**

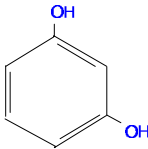
**ATTACHMENT C-1 (Standard References Searched)**

## CHEMICAL SUMMARY FOR 1,3-BENZENEDIOL

This chemical was identified by one or more suppliers as a bath ingredient for the tin-palladium process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of 1,3-benzenediol are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF 1,3-BENZENEDIOL		
Characteristic/Property	Data	Reference
CAS No.	108-46-3	
Common Synonyms	resorcinol: m-dihydroxybenzene	Budavari et al. 1989
Molecular Formula	C <sub>6</sub> H <sub>6</sub> O <sub>2</sub>	Budavari et al. 1989
Chemical Structure		Budavari et al. 1989
Physical State	white, needle-like crystals	Budavari et al. 1989
Molecular Weight	110.11	Budavari et al. 1989
Melting Point	109-111 °C	Budavari et al. 1989
Boiling Point	280 °C	Budavari et al. 1989
Water Solubility	1 g in 0.9 mL	Budavari et al. 1989
Density	1.272	Budavari et al. 1989
Vapor Density (air = 1)	3.79	Keith and Walters 1985
K <sub>oc</sub>	10.36, measured	HSDB 1995
Log K <sub>ow</sub>	0.80, measured	CHEMFATE 1995
Vapor Pressure	2 x 10 <sup>-4</sup> mm Hg @ 25 °C	Keith and Walters 1985
Reactivity	hygroscopic; sensitive to light, air; may react with iron incompatible: acetanilide, albumin, alkalies, antipyrine, camphor, ferric salts, menthol, spirit nitrous ether, urethan	Keith and Walters 1985
Flammability	combustible	Keith and Walters 1985
Flash Point	127.2 °C	Keith and Walters 1985
Dissociation Constant	pK <sub>a</sub> , 9.32, measured	CHEMFATE 1995
Henry's Law Constant	7.11 x 10 <sup>-10</sup> @ 30 °C	HSDB 1995
Molecular Diffusivity Coefficient	8.1 x 10 <sup>-11</sup> atm-m <sup>3</sup> /mole @ 25 °C	HSDB 1995
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	2.4 (estimated)	HSDB 1995
Conversion Factors	faint, characteristic odor	Allan 1994
	1 mg/m <sup>3</sup> = 0.22 ppm;	Calculated using:
	1 ppm = 4.55 mg/m <sup>3</sup>	ppm = 1 mg/m <sup>3</sup> x 24.45/MW

## II. ENVIRONMENTAL FATE

## A. Environmental Release

1,3-Benzenediol may be released into the environment in waste effluents associated with coal gassification and conversion, coal-tar production, shale oil processing, and from the combustion of wood and tobacco (HSDB 1995). 1,3-Benzenediol is found in cigarette smoke (HSDB 1995). 1,3-

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Benzenediol is not one of the chemicals reported to the Toxics Release Inventory (TRI) by certain types of U.S. industries.

### B. Transport

1,3-Benzenediol is expected to leach readily in soil; however, leaching may not be important if concurrent biodegradation occurs at a rapid rate (HSDB 1995).

### C. Transformation/Persistence

1. Air — If released to the atmosphere, 1,3-benzenediol can be expected to exist almost entirely in the gas-phase in the ambient atmosphere. Gas-phase 1,3-benzenediol is expected to degrade rapidly in air (estimated half-life 1.9 hours) by reaction with photochemically produced hydroxyl radicals. Night-time reaction with nitrate radicals may also contribute to atmospheric transformation (HSDB 1995).
2. Soil — 1,3-Benzenediol is readily degradable in soil. The degradation rate decreases at low temperatures (CHEMFATE 1995).
3. Water — 1,3-Benzenediol is confirmed to be significantly degradable in water (CHEMFATE 1995). By analogy to other phenol compounds, 1,3-benzenediol may react relatively rapidly in sunlit natural water with photochemically produced oxidants such as hydroxyl and peroxy radicals (HSDB 1995). Hydrolysis, volatilization, and adsorption to sediments are not expected to be important (HSDB 1995).
4. Biota — Bioconcentration of 1,3-benzenediol is not expected to be important (HSDB 1995).

## CHEMICAL SUMMARY FOR 1 H-PYRROLE

This chemical was identified by one or more suppliers as a bath ingredient for the conductive polymer process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of 1H-pyrrole are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF 1H-PYRROLE		
Characteristic/Property	Data	Reference
CAS No.	109-97-7	
Common Synonyms	pyrrole; azole; divinylbenzimidazole; imidole	Trochimowicz et al. 1994
Molecular Formula	C <sub>4</sub> H <sub>5</sub> N	Trochimowicz et al. 1994
Chemical Structure		
Physical State	liquid (colorless when freshly distilled)	Budavari et al. 1996
Molecular Weight	67.09	Budavari et al. 1996
Melting Point	-23°C	Trochimowicz et al. 1994
Boiling Point	129.8°C @ 760 mm Hg	Budavari et al. 1996
Water Solubility	sparingly soluble	Budavari et al. 1996
Density	specific gravity, 0.9691 <sup>204</sup>	Trochimowicz et al. 1994
Vapor Density (air = 1)	2.31	Trochimowicz et al. 1994
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	0.75 (measured)	Mackay et al. 1995
Vapor Pressure	1100-1136 Pa @ 25°C (8.3-8.5 mm Hg) <sup>a</sup>	Mackay et al. 1995
Reactivity	can react with oxidizing materials; when heated to decomposition, emits highly toxic fumes of oxides of nitrogen	HSDB 1996
Flammability	must be moderately heated before ignition occurs	HSDB 1996
Flash Point	102°F (390°C)	Budavari et al. 1996
Dissociation Constant	pK <sub>a</sub> -3.8 to -4.4	Mackay et al. 1995
Henry's Law Constant	1.640 Pa m <sup>3</sup> /mol (calculated) (1.6 x 10 <sup>-5</sup> atm-m <sup>3</sup> /mol) <sup>b</sup>	Mackay et al. 1995
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	not found	
Conversion Factors	1 ppm = 2.74 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.36 ppm	HSDB 1996

a) mm Hg calculated from Pa based on the formula: mm Hg = Pa ÷ 1.333 x 10<sup>2</sup> (Lukens 1979).

b) Pa converted to atm by the following formula: atm = Pa ÷ 1.013 x 10<sup>5</sup> (Lukens 1979).

## II. ENVIRONMENTAL FATE

## A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of 1H-pyrrole. 1H-pyrrole is one of a group of compounds containing five-membered rings with one or more nitrogen atoms (Trochimowicz et al. 1994). The industrial use of the simpler members of this group of chemicals is limited (Trochimowicz et al. 1994). 1H-pyrrole may be released to the environment from plants that manufacture it or use it either as a chemical intermediate in the production of drugs, dyes, herbicides, and perfumes, or as a cross-linking agent for resins (HSDB 1996). However, its limited use would likely preclude the release of large volumes of the chemical to the environment. 1H-pyrrole occurs naturally as part of the

structure of pigments such as bilirubin and heme and is a constituent of coal tar and bone oil (Trochimowicz et al. 1994).

### B. Transport

No information was found in the secondary sources searched regarding the environmental transport of 1H-pyrrole. The vapor pressure (1100-1136 Pa [Mackay et al. 1995]) and the Henry's Law Constant ( $1.6 \times 10^{-5}$  atm-m<sup>3</sup>/mol) of the chemical indicate that some volatilization from soil or water could occur. 1H-pyrrole is slightly soluble in water and small amounts may move through the soil, possibly to groundwater.

### C. Transformation/Persistence

1. Air — 1H-pyrrole in air would undergo oxidation, probably within hours. For gas-phase reaction at room temperature the rate constant has been estimated at  $1.2 \times 10^{-10}$  cm<sup>3</sup> molecule<sup>-1</sup> sec<sup>-1</sup>, assuming the concentration of OH radicals to be  $1 \times 10^6$ /cm<sup>3</sup> during the daytime. This value corresponds to a calculated lifetime of 2.3 hours (Mackay et al. 1995). In other studies, the calculated lifetime was 1.4 minutes for reaction with NO<sub>3</sub> radicals during nighttime hours and 24 hours for reaction with O<sub>3</sub> molecules (Mackay et al. 1995).
2. Soil — No information was found in the secondary sources searched regarding the degradation of 1H-pyrrole in the soil.
3. Water — No information was found in the secondary sources searched regarding the degradation of 1H-pyrrole in water.
4. Biota — The log K<sub>OW</sub> for 1H-pyrrole (0.75 [Mackay et al. 1995]) indicates that the chemical has a low to moderate potential to bioaccumulate in aquatic organisms.

## CHEMICAL SUMMARY FOR 2-BUTOXYETHANOL ACETATE

This chemical was identified by one or more suppliers as a bath ingredient for the conductive ink process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online data bases, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of 2-butoxyethanol acetate are listed below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF 2-BUTOXYETHANOL ACETATE		
Characteristic/Property	Data	Reference
CAS No.	112-07-2	
Common Synonyms	ethylene glycol monobutyl ether acetate; Butyl Cellosolve acetate	HSDB 1996
Molecular Formula	C <sub>8</sub> H <sub>16</sub> O <sub>3</sub>	Gingell et al. 1994
Chemical Structure	C <sub>4</sub> H <sub>9</sub> -O-(CH <sub>2</sub> ) <sub>2</sub> -OCOCH <sub>3</sub>	NIOSH 1994
Physical State	colorless liquid	HSDB 1996
Molecular Weight	160.21	Gingell et al. 1994
Melting Point	-64.5°C	Howard 1993
Boiling Point	192.3°C	Howard 1993
Water Solubility	15,000 mg/L at 20°C	Verschuereen 1996
Density	0.9422 @ 20/20°C	HSDB 1996
Vapor Density (air = 1)	5.5	HSDB 1996
K <sub>oc</sub>	26 (calculated)	HSDB 1996
Log K <sub>ow</sub>	1.51 (measured)	Verschuereen 1996
Vapor Pressure	0.375 mm Hg @ 20°C	Howard 1993
Reactivity	can react with oxidizers	NIOSH 1994
Flammability	NFPA rating = 2; must be moderately heated before ignition can occur	HSDB 1996
Flash Point	71°C (160°F) (closed cup)	HSDB 1996
Dissociation Constant	no data	
Air Diffusivity Constant	no data	
Molecular Diffusivity Constant	no data	
Henry's Law Constant	7.19 x 10 <sup>-6</sup> atm-m <sup>3</sup> /mole	Howard 1993
Fish Bioconcentration Factor	3.2 (calculated)	Howard 1993
Odor Threshold	0.10 ppm, abs. perception limit; 0.35 ppm, 50% recognition; 0.48 ppm, 100% recognition	Verschuereen 1996
Conversion Factors	1 ppm = 6.64 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.15 ppm	Verschuereen 1996

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

2-Butoxyethanol acetate may be released to the atmosphere by evaporation when it is used as a solvent in paints, lacquers, thinners, inks, and resins. The emission rate into the atmosphere from painting operations in an automobile assembly plant in Wisconsin was estimated at 37.9 gallons/hour (Howard 1993). 2-Butoxyethanol acetate was detected in 0.4% of 275 solvent products that were sampled in various industries and analyzed between 1978 and 1982 (HSDB 1996).

In 1993, releases of all glycol ethers to environmental media, as reported in the TRI by certain types of industries, totaled about 45.9 million pounds; 2-butoxyethanol acetate is not listed separately (TRI93 1995).



### B. Transport

The estimated relatively low  $K_{oc}$  of 26 suggests that 2-butoxyethanol acetate can leach readily into groundwater from soils. However, if rapid biodegradation occurs, leaching may be less important. Volatilization from water is expected to be slow, with the possible exception from very shallow rivers. Physical removal via wet deposition is likely because the chemical is soluble in water (Howard 1993; HSDB 1996).

### C. Transformation/Persistence

1. Air — Based on a vapor pressure of 0.375 mm Hg at 20°C, 2-butoxyethanol acetate should exist almost entirely in the vapor phase in the atmosphere. It is expected that 2-butoxyethanol acetate will degrade by reaction with hydroxyl radicals with an estimated half-life of about 18.4 hours (HSDB 1996).
2. Soil — When released to soils, biodegradation is expected to be the most important removal process. One biodegradation screening study demonstrated that the chemical is readily (>90%) biodegraded (HSDB 1996).
3. Water — Biodegradation is likely to be the most important removal mechanism of 2-butoxyethanol acetate from aquatic systems. In a screening assay, 2-butoxyethanol acetate total degradation exceeded 90%, with a measured rate of 12%/day under the test conditions. No observable lag period was required before onset of degradation. Estimated volatilization half-lives from a model river (1 meter deep) and model pond are 6.6 and 74 days, respectively. Adsorption to sediment is not expected to be important (HSDB 1996).
4. Biota — The estimated bioconcentration factor of 3.2 suggests that 2-butoxyethanol acetate would not bioconcentrate significantly in aquatic organisms (Howard 1993).

## CHEMICAL SUMMARY FOR 2-ETHOXYETHANOL

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of 2-ethoxyethanol are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF 2-ETHOXYETHANOL		
Characteristic/Property	Data	Reference
CAS No.	110-80-5	
Common Synonyms	ethylene glycol monoethyl ether; Cellusolve; Oxitol	Budavari et al. 1996
Molecular Formula	$C_4H_{10}O_2$	Budavari et al. 1996
Chemical Structure	$HOCH_2CH_2OC_2H_5$	Budavari et al. 1996
Physical State	colorless liquid	Budavari et al. 1996
Molecular Weight	90.12	Budavari et al. 1996
Melting Point	-70°C	Budavari et al. 1996
Boiling Point	135°C	Budavari et al. 1996
Water Solubility	miscible	Budavari et al. 1996
	≥ 100 mg/mL	Keith and Walters 1985
Density	0.93	Budavari et al. 1996
Vapor Density (air = 1)	3.10	Verschuereen 1996
$K_{oc}$	0.12 (calculated)	Howard 1990
Log $K_{ow}$	-0.10	Howard 1990
Vapor Pressure	3.8 mm Hg at 20°C	Verschuereen 1996
Reactivity	reacts with strong oxidizers	Keith and Walters 1985
Flammability	combustible	Keith and Walters 1985
Flash Point	44°C (closed cup) 49°C (open cup)	Budavari et al. 1996
Dissociation Constant	no data	
Henry's Law Constant	$5.13 \times 10^{-2}$ atm-m <sup>3</sup> /mol	Howard 1990
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	0.55 ppm (50% recognition) 1.33 ppm (100% recognition)	Verschuereen 1996 Verschuereen 1996
Conversion Factors	1 ppm = 3.75 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.27 ppm	Verschuereen 1996

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Environmental release of 2-ethoxyethanol can occur from wastewater effluents and atmospheric emissions from production and use facilities. Information on the amount of 2-ethoxyethanol released to the environment was not found in the secondary sources searched. Chemical concentrations detected in the Hayashida River (Japan) were 250-1200 ppb (Howard 1990; U.S. EPA 1985a). Effluent from a facility in Brandenburg, KY contained 0.10 µg/L in 1974 (U.S. EPA 1985a).

### B. Transport

The Henry's Law constant of  $5.13 \times 10^{-2}$  atm-m<sup>3</sup>/mol (Howard 1990) indicates rapid volatilization from soils and surface waters. The complete water solubility and low K<sub>OC</sub> indicate that leaching from soils into ground water may occur.

### C. Transformation/Persistence

1. Air — In the atmosphere, 2-ethoxyethanol will react with both nitrogen oxides and hydroxyl radicals. The half-life of the chemical was 9.8 hour when mixed with nitrogen oxides (20:1, 2-ethoxyethanol:nitrogen dioxides) in a smog chamber. For reaction with photochemically produced hydroxy radicals, the estimated half-life is 11.41 hours (Howard 1990).
2. Soil — Volatilization and biodegradation are the main removal mechanisms for 2-ethoxyethanol from soils. Adsorption is not expected to be significant, so leaching into ground waters may occur (Howard 1990). A soil microbe acclimated to triethylene glycol was capable of utilizing 2-ethoxyethanol as a sole carbon source. In a standard evaporation test at 77°C and 15% relative humidity, 100% loss of the chemical occurred in 20 minutes (U.S. EPA 1985a).
3. Water — 2-Ethoxyethanol will volatilize readily from surface waters with biodegradation also contributing to removal. After incubation of the chemical for 5 days with either sewage seed or activated sludge, 7.6% and up to 65%, respectively, of the theoretical biological oxygen demand was achieved. Adsorption to suspended particulates and sediments is not expected to occur (Howard 1990). Hydrolysis of 2-ethoxyethanol is not expected to be important (U.S. EPA 1985a).
4. Biota — Based on the complete water solubility and low K<sub>OW</sub> of 2-ethoxyethanol, the chemical is not expected to accumulate in aquatic organisms (U.S. EPA 1985a).

## CHEMICAL SUMMARY FOR AMMONIA

This chemical was identified by one or more suppliers as a bath ingredient for the graphite process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of ammonia are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF AMMONIA		
Characteristic/Property	Data	Reference
CAS No.	7664-41-7	
Common Synonyms	ammonia gas; liquid ammonia; ammonia, anhydrous; Spirit of Hartshorn; Nitro-Sil	Lockheed Martin 1995a
Molecular Formula	H <sub>3</sub> N	
Chemical Structure	$\begin{array}{c} \text{H}-\text{N}-\text{H} \\   \\ \text{H} \end{array}$	
Physical State	colorless gas	Budavari et al. 1989
Molecular Weight	17.03	Budavari et al. 1989
Melting Point	-77.7°C	Budavari et al. 1989
Boiling Point	-33.35°C	Budavari et al. 1989
Water Solubility	47% @ 0°C; 38% @ 15°C; 34% @ 20°C	Budavari et al. 1989
Density	0.7710 g/L (gas)	ATSDR 1990a
Vapor Density (air = 1)	0.59	HSDB 1995
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	7.508 × 10 <sup>3</sup> mm Hg @ 25°C	CHEMFATE 1995
Reactivity	incompatible with halogens, acid chlorides, acid, acid anhydrides, oxidizing agents, chloroformates, galvanized iron; reacts with zinc, copper, tin, and their alloys; pH of 1N solution = 11.6	Lockheed Martin 1995a Budavari et al. 1989
Flammability	flammable	
Flash Point	no data; autoignition @ 649°C	Lockheed Martin 1995a
Dissociation Constant	pK <sub>a</sub> = 9.249; pK <sub>b</sub> = 4.751 @ 25°C	U.S. EPA 1981a
Henry's Law Constant	7.3 × 10 <sup>-6</sup> atm-m <sup>3</sup> /mole (pH 7, 23.4°C) 1.6 × 10 <sup>-5</sup> atm-m <sup>3</sup> /mole (25°C)	ATSDR 1990a
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	1.5 ppm (water); 25 ppm (air)	ATSDR 1990a
Conversion Factors	1 ppm = 0.708 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 1.41 ppm	ATSDR 1990a

## II. ENVIRONMENTAL FATE

## A. Environmental Release

Ammonia is an important component of the nitrogen cycle such that concentrations in nature and natural media are in dynamic equilibrium (ATSDR 1990a). Natural sources of ammonia include volcanic eruptions, forest fires, microbial fixation of nitrogen, microbial decomposition of dead plants and animals, and decay of livestock, pet, and human wastes (ATSDR 1990a). Approximately 80% of the ammonia produced in the U.S. is applied to soils as fertilizer (ATSDR 1990a).

Average concentrations have been measured at <0.18 mg/L in surface waters and approximately 0.5 mg/L in waters near metropolitan areas; concentrations were lower in the summer than in the winter (U.S. EPA 1981a). Average global atmospheric ammonia concentrations are 1-3 ppb (ATSDR 1990a).

In 1993, as reported to the TRI, a total of 353 million pounds of ammonia were released to the environment. Of the total, 138 million pounds were released to the atmosphere, 36 million pounds were released surface waters, 169 million pounds were released to underground injection sites, and 10 million pounds were released to land (TRI93 1995).

### B. Transport

As a key component of the nitrogen cycle, ammonia in water and soils undergoes microbial mediated nitrification. The resulting nitrates are assimilated into plants and other microbes. This process is dependent upon dissolved oxygen, temperature, pH, the microbial population, and the nitrogen forms present (U.S. EPA 1981a; ATSDR 1990a). From natural waters, ammonia also volatilizes to the atmosphere or strongly adsorbs to sediment so that leaching is not likely (U.S. EPA 1981a). Once in the atmosphere, the chemical can be removed in rain or snow or dissolve in clouds (ATSDR 1990a).

### C. Transformation/Persistence

1. Air — In the atmosphere, ammonia reacts with acid air pollutants such as  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  to form particulate ammonium compounds that can be removed by wet or dry deposition (ATSDR 1990a). In unpolluted air, the half-life for ammonia reaction with hydroxyl radicals is about 16 days (U.S. EPA 1981a).
2. Soil — In soils, ammonia is transformed to nitrate by soil microbes and taken up by plants as a nutrient source. The ammonium cation adsorbs to negatively charged clay colloids in soils and is relatively immobile. Volatilization is another removal mechanism from soil (ATSDR 1990a; U.S. EPA 1981a).
3. Water — In natural waters, ammonia undergoes nitrification with the products being taken up by aquatic plants or other organisms. Ammonia can also adsorb to sediments or volatilize to the atmosphere (ATSDR 1990a; U.S. EPA 1981a).
4. Biota — Ammonia is a natural waste product of fish and is released to the surrounding water through the gills. If water concentrations are abnormally high, the concentration gradient is reversed and the direction of passive transport is into the gills (ATSDR 1990a).

## CHEMICAL SUMMARY FOR AMMONIUM CHLORIDE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of ammonium chloride are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF AMMONIUM CHLORIDE		
Characteristic/Property	Data	Reference
CAS No.	12125-02-9	
Common Synonyms	ammonium muriate; sal ammoniac	Sax and Lewis 1989
Molecular Formula	ClH <sub>4</sub> N	Budavari et al. 1989
Chemical Structure	H <sub>4</sub> N-Cl	
Physical State	white crystalline solid, somewhat hygroscopic	ACGIH 1991
Molecular Weight	53.50	Budavari et al. 1989
Melting Point	sublimes @ 350°C without melting	ACGIH 1991
Boiling Point	520°C	Sax and Lewis 1989
Water Solubility	28.3% (w/w) @ 25°C	Budavari et al. 1989
Density	1.5274 at 25°C	Budavari et al. 1989
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	1 mm Hg @ 160.4°C	Sax and Lewis 1989
Reactivity	reacts with alkalis & their carbonates; lead & silver salts; strong oxidizers; ammonium nitrate; potassium chlorate; and bromine trifluoride; corrodes most metals	NIOSH 1994
Flammability	not flammable	HSDB 1995
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	Budavari et al. 1989
Conversion Factors	no data	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Ammonium chloride, a somewhat hygroscopic crystalline solid with a cooling saline taste, is highly soluble in water (Budavari et al. 1989). It is used in dry batteries; soldering; manufacture of various ammonia compounds; as a fertilizer; in electroplating; in medicine; and in the food industry (ACGIH 1991; Verschueren 1983). Large amounts of ammonium chloride are frequently evolved from galvanizing operations, with concentrations generally below 5 mg/m<sup>3</sup>, although peak concentrations are higher (ACGIH 1991). Ammonium chloride occurs naturally in crevices in the vicinity of volcanoes (Young 1978).

#### B. Transport

No information on the transport of ammonium chloride was found in the secondary sources searched. The water solubility suggests that the chemical would leach through soil.

### **C. Transformation/Persistence**

No information on the transformation/persistence of ammonium chloride was found in the secondary sources searched. Low vapor pressure and its water solubility suggest the chemical would remain in the aqueous phase.

## CHEMICAL SUMMARY FOR BENZOTRIAZOLE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of benzotriazole are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF BENZOTRIAZOLE		
Characteristic/Property	Data	Reference
CAS No.	95-14-7	
Common Synonyms	1,2,3-benzotriazole; 1H-benzotriazole; azimino-benzene; 1,2-aminozophenylene; benzene azimide	RTECS 1995
Molecular Formula	C <sub>6</sub> H <sub>5</sub> N <sub>3</sub>	
Chemical Structure		
Physical State	white to light tan crystalline powder	HSDB 1995
Molecular Weight	119.14	RTECS 1995
Melting Point	98.5°C	HSDB 1995
Boiling Point	204°C @ 15 mm Hg	HSDB 1995
Water Solubility	19.8 g/L @ 25°C (measured)	CHEMFATE 1995
Density	not found	
Vapor Density (air = 1)	not found	
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	1.34 (measured)	CHEMFATE 1995
Vapor Pressure	0.4 x 10 <sup>-1</sup> Torr @ 20°C (measured)	CHEMFATE 1995
Reactivity	stable toward acids, alkalis, oxidation and reduction; forms stable metallic salts; may explode during vacuum distillation	HSDB 1995
Flammability	1.6 @ 20°C (measured)	CHEMFATE 1995
Flash Point	not found	
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	not found	
Conversion Factors	1 ppm = 4.87 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.205 ppm	Calculated using: ppm = mg/m <sup>3</sup> x 24.45/m.w

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Benzotriazole may be released to the environment during its production and its use in a wide range of commercial products. Uses of the chemical include: as a chemical intermediate; as a pickling inhibitor in boiler scale removal; as a restrainer, developer and antifogging agent in photographic emulsions; as a corrosion inhibitor for copper; as a component of military deicing fluid; and as a plastics stabilizer (HSDB 1995). The NCI (1977) selected the chemical for study in the bioassay program because of its use in dishwashing detergents and the possibility that such use could result in the contamination of water supplies.

#### B. Transport

The considerable water solubility of benzotriazole (19.8 g/L [CHEMFATE 1995]) suggests that the chemical may exist in solution in the soil and leach into ground water. The low vapor pressure (0.04 Torr at 20°C [CHEMFATE 1995]) indicates that volatilization is not a significant transport



mechanism for benzotriazole in soil or water. In one instance, benzotriazole evaporated from water in 438 hours (~18 days) (CHEMFATE 1995). Because of its water solubility, benzotriazole present in the atmosphere may be removed by wet deposition.

### C. Transformation/Persistence

1. Air — No information was found in the secondary sources searched regarding the transformation/persistence of benzotriazole in air. The considerable water solubility of benzotriazole (see section II.B) suggests that the chemical would be removed from the atmosphere by wet deposition.
2. Soil — The sensitivity of benzotriazole to photodegradation is solvent-dependent (CHEMFATE 1995). The chemical was 100% degraded when irradiated for 60 hours at 300 nm in methanol (CHEMFATE 1995). The products of degradation (also solvent-dependent) were aniline (1-1.6%) and *O*-anisidine (2-8.2%).
3. Water — In one study, benzotriazole as the sole source of carbon was not degraded by acclimated sludge in water (CHEMFATE 1995). Other investigators observed that elective cultures and continuous enrichment failed to biodegrade benzotriazole and indicated that the chemical is expected to resist degradation in the environment (Rollinson and Calley 1986). In the aquatic environment, the chemical could undergo some photolysis at the water's surface (see section II.C.2).
4. Biota — The log octanol/water partition coefficient for benzotriazole, 1.34 (CHEMFATE 1995), suggests that the chemical has a low to moderate potential for partitioning to lipids. However, no information was found to indicate whether the chemical will bioaccumulate.

## CHEMICAL SUMMARY FOR BORIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of boric acid are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF BORIC ACID		
Characteristic/Property	Data	Reference
CAS No.	10043-35-3	
Common Synonyms	boracic acid orthoboric acid	Budavari et al. 1989 HSDB 1995
Molecular Formula	H <sub>3</sub> BO <sub>3</sub>	
Chemical Structure		
Physical State	colorless, odorless, transparent crystals; or white granules or powder	Budavari et al. 1989
Molecular Weight	61.84	Budavari et al. 1989
Melting Point	171 °C	Budavari et al. 1989
Boiling Point	300 °C	U.S. EPA 1990a
Water Solubility	1 g/18 ml cold H <sub>2</sub> O	Budavari et al. 1989
Density	1.435 @ 15 °C	U.S. EPA 1990a
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	low for boron compounds	U.S. EPA 1990
Reactivity	incompatible with alkali carbonates and hydroxides mixtures with potassium may explode on impact	Budavari et al. 1989 HSDB 1995
Flammability	not flammable	HSDB 1995
Flash Point	not flammable	HSDB 1995
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	Budavari et al. 1989
Conversion Factors	no data	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Boric acid is a naturally occurring compound formed from the breaks of other boron compounds. It is released into the atmosphere during volcanic eruptions; however, most of this is captured by the oceans. Boric acid also enters the environment as a contaminant from the manufacture and industrial and household use of boron-containing compounds; the mining and processing of borax; coal, oil and geothermal power generation; and sewage and sludge disposal (U.S. EPA 1990a). Boric acid is not listed on the EPA's TRI, requiring certain types of U.S. industries to report on chemical releases to the environment.

#### B. Transport

Groundwater movement studies indicate that boron is relatively mobile in sand and gravel aquifers, with retardation only occurring as a result of adsorption to clay or organic materials. An equilibrium exists between adsorbed and dissolved boron in soils (U.S. EPA 1990a).

### C. Transformation/Persistence

1. Air — Boron does not appear to persist in the atmosphere as a vapor. As a particulate, boron can be removed by either wet or dry deposition (U.S. EPA 1990a).
2. Soil — Boric acid is adsorbed onto soil at acidic pH levels, and does not appear to be chemically or biologically degraded in soils (U.S. EPA 1990a).
3. Water — In natural waters, boron does not appear to be chemically or biologically degraded, but exists as undissociated boric acid (U.S. EPA 1990a). Because of its low vapor pressure, volatilization is not expected to be a contributing factor for the release of boron at the air-water interface (U.S. EPA 1990a).
4. Biota — No specific information was found in the secondary sources searched regarding the bioaccumulation of boric acid. However, boron accumulation appears to occur in relation to its availability in the surrounding aquatic systems. Tissue concentrations of boron in fish from freshwater aquatic systems of varying water quality containing boron or boron compounds (not necessarily just boric acid) have been reported to range from 1.8  $\mu\text{g/g}$  in lake charr from a Precambrian shield lake to 20  $\mu\text{g/g}$  in carp from a river system receiving agricultural subsurface drainage (U.S. EPA 1990a).

## CHEMICAL SUMMARY FOR CARBON BLACK

This chemical was identified by one or more suppliers as a bath ingredient for the carbon and conductive ink processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of carbon black are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF CARBON BLACK		
Characteristic/Property	Data	Reference
CAS No.	1333-86-4	
Common Synonyms	lamp black; thermal black; furnace black; acetylene black; channel black; CI pigment black 7; philblack N 550; raven; regal; carbon, amorphous	HSDB 1996
Molecular Formula	C	
Chemical Structure	microscopic hexagonal crystallites oriented randomly	U.S. EPA 1981b
Physical State	extremely fine, smoke-like powder; black	HSDB 1996
Molecular Weight	12; may vary with manufacturing process	NIOSH 1994; U.S. EPA 1981b
Melting Point	sublimates @ 3652-3697°C	HSDB 1996
Boiling Point	4200°C; 4827°C	HSDB 1996; U.S. EPA 1981b
Water Solubility	insoluble	U.S. EPA 1981b
Density	1.8-2.1	U.S. EPA 1981b
Vapor Density (air = 1)	not applicable	
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	not found	
Vapor Pressure	0 mm Hg (approximately)	NIOSH 1994
Reactivity	reacts with strong oxidizers, such as chlorates, bromates and nitrates; carbon dust may form explosive mixtures in air	NIOSH 1994; HSDB 1996
Flammability	flammable	HSDB 1996
Flash Point	not found	
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	odorless	HSDB 1996
Conversion Factors	not applicable	

Analytical properties of commercially produced carbon blacks (all with CAS No. 1333-86-4) are summarized below. Contaminants, including polynuclear aromatic hydrocarbons (PAHs), adsorb to carbon-black particles (IARC 1984). These contaminants (some are known carcinogens) are extractable with organic solvents such as benzene, naphthalene, and toluene (IARC 1984). The efficiency of the extraction depends on the solvent, extraction time, type of carbon black, relationship between sample weight/solvent volume and the amount of extractable material. The bioavailability of these potential carcinogens is an important issue in the assessment of the health effects of carbon black (IARC 1984). Available evidence indicates that when carbon blacks are exposed to biological material, including human albumin, some release of PAHs occurs, depending on the amount of adsorbed material and the available adsorptive surface (IARC 1984).

## APPENDIX C

**Analytical Data for Carbon Blacks Produced Commercially in the U.S.**

Property	Channel Black <sup>a</sup>	Acetylene	Furnace	Lampblack	Thermal	
					Medium	Fine
Average particle diameter (nm)	29	40	28	65	500	180
Benzene extract (%)		0.1	0.06	0.2	0.3	0.8
pH	acidic	4.8	7.5	3.0	8.5	9.0
Volatile material (%)	5-17%	0.3	1.0	1.5	0.5	0.5
Composition (%)						
Carbon		99.7	97.9	98	99.3	99.2
Hydrogen		0.1	0.4	0.2	0.3	0.5
Sulfur		0.02	0.6	0.8	0.01	0.01
Oxygen		0.2	0.7	0.8	0.1	0.3

a) No longer produced in the U.S. Certain carbon blacks made in Germany by an impingement process reportedly have the same properties as the old channel black (IARC 1984). Only general properties were available for channel black.

Source: IARC (1984)

## II. ENVIRONMENTAL FATE

### A. Environmental Release

Carbon black may be released to the environment from various production facilities and from rubber tires in which carbon black is used as a reinforcing agent (U.S. EPA 1981b). The objective of the carbon-black industry is to produce large quantities of dense carbon smoke that would, under ordinary circumstances, be considered an undesired by-product (U.S. EPA 1981b). Consequently, for economic reasons, releases from production facilities are limited by highly efficient collection methods. In the thermal and furnace process plants, systems of electrostatic precipitators, cyclones, and bag filters collect over 99% of the black (U.S. EPA 1981b). In the channel production process (no longer used in the U.S.), carbon black was collected by a less effective method, impingement on long-channel irons, and larger quantities of carbon black were released (U.S. EPA 1981b). Releases to the atmosphere may also occur during maintenance procedures, from leaks in plant conveying systems, or during loading and unloading operations (U.S. EPA 1981b). In 1979, average particulate carbon-black emissions during the manufacture of carbon blacks by the oil furnace process ranged from 0.1 kg/thousand kg for fugitive emissions to 3.27 kg/thousand kg from uncontrolled main process vents (IARC 1984). More recent monitoring data were not found in the secondary sources searched.

As a result of tire wear, carbon black is deposited in significant quantities along roadways, apparently settling out within a few feet of the road (U.S. EPA 1981b).

In 1978, the U.S. EPA issued its final regulation on water discharge permits that called for zero discharge of carbon black using the best available technology (U.S. EPA 1981b).

### B. Transport

Carbon black entering the atmosphere or lost from tires ultimately enters the soil or is washed into the waterways (U.S. EPA 1981b). No other information was found in the secondary sources searched regarding environmental transport of carbon black.

### C. Transformation/Persistence

No information was found in the secondary sources searched regarding the transformation/persistence of carbon black in the atmospheric, aquatic, or terrestrial environment or in biota. It is expected to be inert under normal conditions (U.S. EPA 1981b).

## CHEMICAL SUMMARY FOR COPPER AND SELECTED COPPER COMPOUNDS

These chemicals were identified by one or more suppliers as bath ingredients for the electroless copper, carbon, graphite, non-formaldehyde electroless copper, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of copper, cupric sulfate, cuprous chloride, cupric chloride, and cupric ethylenediaminetetraacetate (Cu-EDTA) are summarized below.

#### CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF COPPER

Characteristic/Property	Data	Reference
CAS No.	7440-50-8	
Common Synonyms	None	
Molecular Formula	Cu	
Chemical Structure	Cu <sup>0</sup>	
Physical State	Reddish metal	U.S. EPA 1987a
Molecular Weight	63.55	U.S. EPA 1987a
Melting Point	1083.4°C	U.S. EPA 1987a
Boiling Point	2567°C	U.S. EPA 1987a
Water Solubility	Insoluble (as Cu <sup>0</sup> )	U.S. EPA 1987a
Specific Gravity	8.92	U.S. EPA 1987a
Vapor Density (air = 1)	No data	
K <sub>OC</sub>	No data	
Log K <sub>OW</sub>	No data	
Vapor Pressure	1 mm Hg @ 1629°C	U.S. EPA 1987a
Reactivity	Reacts with dil. HNO <sub>3</sub> , conc. H <sub>2</sub> SO <sub>4</sub> , and organic acids; slowly with HCl in the presence of oxygen. Forms carbonate salt on the metal surface in moist air. Forms soluble salts on the metal surface in water. Violent reaction with hydrazoic acid, hydrogen sulfide, lead azide, sodium azide, hydrazine mono-nitrate, ammonium nitrate, bromates, chlorates, iodates, chlorine, fluorine, and peroxides. Can react with acetylene to form explosive acetylides.	Budavari et al. 1989 U.S. Air Force 1990 HSDB 1995
Flammability	No data	
Flash Point	No data	
Dissociation Constant	No data	
Henry's Law Constant	No data	
Molecular Diffusivity Coefficient	No data	
Air Diffusivity Coefficient	No data	
Fish Bioconcentration Factor	10-100	ATSDR 1990b
Shellfish Bioconcentration Factor	30,000 in oysters	ATSDR 1990b
Taste Threshold (copper in water)	2.6 ppm	ATSDR 1990b
Conversion Factors	Not applicable, associated with particulate matter	

## APPENDIX C

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF CUPRIC SULFATE		
Characteristic/Property	Data	Reference
CAS No.	7758-98-7	
Common Synonyms	Copper Sulfate; Blue Vitriol	ATSDR 1990b
Molecular Formula	CuSO <sub>4</sub>	ATSDR 1990b
Chemical Structure	CuO <sub>4</sub> S	ATSDR 1990b
Physical State	Solid, White powder (anhydrous), blue crystals (hydrated)	ATSDR 1990b
Molecular Weight	159.60 (dehydrated) 249.68 (pentahydrate)	ATSDR 1990b U.S. EPA 1987a
Melting Point	Decomposes @ 110°C	U.S. EPA 1987a
Boiling Point	Decomposes to CuO @ 650°C	ATSDR 1990b
Water Solubility	143 g/L @ 0°C	ATSDR 1990b
Specific Gravity	3.603 (anhydrous) 2.284 (pentahydrate)	ATSDR 1990b U.S. EPA 1987a
Vapor Density (air = 1)	No data	
K <sub>oc</sub>	No data	
Log K <sub>ow</sub>	No data	
Vapor Pressure	No data	
Reactivity	Reacts with Mg to produce Cu <sub>2</sub> O, MgSO <sub>4</sub> , and H <sub>2</sub> ; reacts with NH <sub>4</sub> Cl producing (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub> and CuCl <sub>2</sub> ; reacts with alkali (R)OH to produce Cu(OH) <sub>2</sub> and RSO <sub>4</sub> ; reacts with excess aq. NH <sub>3</sub> producing Cu(NH <sub>3</sub> ) <sub>2</sub> <sup>++</sup> + OH <sup>-</sup> ; decomposition products include SO <sub>2</sub> .	U.S. Air Force 1990 HSDB 1995
Flammability	Non-flammable	HSDB 1995
Flash Point	Non-flammable	HSDB 1995
Dissociation Constant	No data	
Henry's Law Constant	No data	
Molecular Diffusivity Coefficient	No data	
Air Diffusivity Coefficient	No data	
Fish Bioconcentration Factor	10-100 for copper	ATSDR 1990b
Shellfish Bioconcentration Factor	30,000 for copper in oysters	ATSDR 1990b
Taste Threshold (copper in water)	2.6 ppm for copper	ATSDR 1990b
Conversion Factors	Not applicable, associated with particulate material	

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF CUPROUS CHLORIDE		
Characteristic/Property	Data	Reference
CAS No.	7758-89-6	
Common Synonyms	Copper (I) chloride	U.S. EPA 1987a
Molecular Formula	CuCl	U.S. EPA 1987a
Chemical Structure	CuCl (or Cu <sub>2</sub> Cl <sub>2</sub> )	U.S. EPA 1987a
Physical State	Solid, White crystal	U.S. EPA 1987a
Molecular Weight	98.99	U.S. EPA 1987a
Melting Point	430°C	U.S. EPA 1987a
Boiling Point	1490°C	U.S. EPA 1987a
Water Solubility	0.062 g/L (cold water)	U.S. EPA 1987a
Specific Gravity	4.14	U.S. EPA 1987a
Vapor Density (air = 1)	No data	
K <sub>oc</sub>	No data	
Log K <sub>ow</sub>	No data	
Vapor Pressure	1 mm Hg @ 546°C	U.S. EPA 1987a
Reactivity	Reactive with oxidizing agents, alkali metals; decomposition products include HCL gas.	Aldrich Chemical Co. 1985
Flammability	Not combustible	
Flash Point	Not combustible	
Dissociation Constant	No data	
Henry's Law Constant	No data	
Molecular Diffusivity Coefficient	No data	
Air Diffusivity Coefficient	No data	
Fish Bioconcentration Factor	10-100 for copper	ATSDR 1990b
Shellfish Bioconcentration Factor	30,000 for copper in oysters	ATSDR 1990b
Taste Threshold (copper in water)	2.6 ppm	ATSDR 1990b
Conversion Factors	Not applicable, associated with particulate material	

## CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF CUPRIC CHLORIDE

Characteristic/Property	Data	Reference
CAS No.	7447-39-4	
Common Synonyms	Copper (II) chloride	U.S. EPA 1987a
Molecular Formula	CuCl <sub>2</sub>	U.S. EPA 1987a
Chemical Structure	CuCl <sub>2</sub>	U.S. EPA 1987a
Physical State	Brown or yellow powder	U.S. EPA 1987a
	Green to blue crystals when hydrated	EM Industries 1987
Molecular Weight	134.44	U.S. EPA 1987a
Melting Point	620 °C	U.S. EPA 1987a
Boiling Point	Decomposes @ 993 °C	U.S. EPA 1987a
Water Solubility	706 g/L @ 0 °C	U.S. EPA 1987a
Specific Gravity	3.386 <sup>4/25</sup>	U.S. EPA 1987a
Vapor Density (air = 1)	No data	
K <sub>oc</sub>	No data	
Log K <sub>ow</sub>	No data	
Vapor Pressure	No data	
Reactivity	HCl gas can be produced in fires or in contact with acids; corrosive to aluminum. Reacts with alkali metals.	U.S. Air Force 1990 EM Industries 1987
Flammability	Not combustible	U.S. Air Force 1990
Flash Point	Not combustible	U.S. Air Force 1990
Dissociation Constant	No data	
Henry's Law Constant	No data	
Molecular Diffusivity Coefficient	No data	
Air Diffusivity Coefficient	No data	
Fish Bioconcentration Factor	10-100 for copper	ATSDR 1990b
Shellfish Bioconcentration Factor	30,000 for copper in oysters	ATSDR 1990b
Taste Threshold (copper in water)	2.6 ppm	ATSDR 1990b
Conversion Factors	Not applicable, associated with particulate material	

## II. ENVIRONMENTAL FATE

## A. Environmental Release

Copper (Cu) commonly exists in three valence states, Cu<sup>0</sup> (metal), Cu<sup>+</sup> (cuprous), and Cu<sup>++</sup> (cupric). It can also be oxidized to a Cu<sup>+++</sup> state, but there are no important industrial Cu<sup>+++</sup> chemicals, and Cu<sup>+++</sup> ions are rapidly reduced to Cu<sup>++</sup> in the environment (ATSDR 1990b). Cupric sulfate and cupric chloride are very soluble in water [143 and 706 g/L, respectively (U.S. EPA 1987a; ATSDR 1990b)] and, when dissolved, become sources of Cu<sup>++</sup> ions; cupro chloride is a source of Cu<sup>+</sup> ions in solution, but it has comparatively low water solubility [0.062 g/L (U.S. EPA 1987a)].

Ethylenediaminetetraacetate (EDTA) has the ability to chelate divalent metal ions such as Cu<sup>++</sup>. The release of Cu<sup>++</sup> from the Cu-EDTA complex depends on the concentration of other divalent metal ions in solution. Copper occurs naturally in the environment primarily as Cu<sup>++</sup> salts, oxides, and complexes; but Cu<sup>+</sup> compounds and metallic copper (Cu<sup>0</sup>) also occur naturally (U.S. EPA 1984a).

Copper and its compounds are ubiquitous in nature as part of the earth's crust and are found in plants and animals (ATSDR 1990b). The average concentration of copper found in the earth's crust is about 50 ppm (ATSDR 1990b).

Releases to the air from natural sources primarily involve windblown dust; however, volcanoes, decaying vegetation, forest fires, and sea water spray also contribute (ATSDR 1990b).

Anthropogenic sources include releases from copper smelting industries, iron and steel industries, coal burning power plants and fabricating operations involving copper (U.S. EPA 1984a). The mean concentration of airborne copper is 5-200 ng/m<sup>3</sup>, which is associated with particulate matter (ATSDR 1990b). Copper is also released to water from industrial and sewage treatment discharges and naturally from soil weathering. Most of this copper is adsorbed to particulate matter. Natural sources of copper account for about 68% of copper released to streams and waterways. Domestic wastewater is the largest anthropogenic source of copper released to water. Copper can enter the drinking water from the water distribution system and



can exceed 1.3 ppm when the pipes have not been flushed during a period of disuse. The total amount of copper released to water was estimated at 28,848,000,000 tons for 1976; this represents about 2.4% of the total amount copper released to the environment. The majority of copper is released to the land primarily from copper mines and mills and is in the form of insoluble sulfides or silicates. Other sources include sludge from sewage treatment plants, municipal refuse, waste from electroplating, iron and steel producers, and discarded copper-containing products (plumbing and wiring) (ATSDR 1990b).

In 1992, releases of copper to environmental media, as reported to the TRI by certain types of U.S. industries, totaled about 55,294,095 pounds of which 41,093,203 pounds were copper compounds and 14,200,892 pounds were metallic copper. Of these amounts, 6,329,997 pounds of copper compounds and 1,495,369 pounds of metallic copper (14.2%) were released to the atmosphere, 72,423 pounds of copper compounds and 41,474 pounds of metallic copper (0.2%) were released to surface water, 201,431 pounds of copper compounds and 16,736 pounds of metallic copper (0.4%) were released in underground injection sites, and 34,489,362 pounds of copper compounds and 12,647,313 pounds of metallic copper (85.2%) were released to land (TRI92 1994).

### B. Transport

### C. Transformation/Persistence

1. Air — Most of the copper in the air is in the form of particulate matter (dust) or is adsorbed to particulate matter. Larger particles ( $>5\ \mu\text{m}$ ) are removed by gravitational settling, smaller particles are removed by other forms of dry and wet deposition (ATSDR 1990b). Atmospheric copper resulting from combustion is associated with sub-micron particles that can remain in the troposphere for an estimated 7-30 days and may be carried long distances (ATSDR 1990b). In southern Ontario, Canada, the average copper concentration in rainwater was 1.57 ppb during 1982, and the average annual wet deposition of copper was  $1.36\ \text{mg}/\text{m}^2$ . The average annual wet deposition for both central and northern Ontario was  $1.13\ \text{mg}/\text{m}^2$  (ATSDR 1990b).
2. Soil — Most of the copper deposited in the soil is strongly adsorbed primarily to organic matter, carbonate minerals, clay minerals, and hydrous iron and manganese oxides. Movement through the soil is dependent on the presence of these substances, the pH, and other physical and chemical parameters. The greatest potential for leaching is seen in sandy soils with low pH (ATSDR 1990b). Laboratory experiments using controlled models and field experiments utilizing core samples have shown that very little copper moves through the soil. Core samples showed that some movement occurred as far as the 22.5-25 cm layer of soil, but little, if any, moved below this zone. The evidence indicates that hazardous amounts of copper should not leach into groundwater from sludge, even from sandy soils (ATSDR 1990b).
3. Water — Copper in solution is present almost exclusively as the  $\text{Cu}^{++}$  valence state (U.S. EPA 1987a). The  $\text{Cu}^+$  ion is unstable in solution and disproportionates to  $\text{Cu}^{++}$  and copper metal unless a stabilizing ligand is present (ATSDR 1990b). In sea water,  $\text{Cu}^+$  was found to be more stable than in fresh water existing as  $\text{CuClOH}^-$  ions. A photochemical reduction mechanism involving  $\text{H}_2\text{O}_2$  is thought to be partly responsible. The presence of  $\text{Cu}^+$  is highest in the surface layer of seawater and can account for as much as 15% of the copper in seawater (ATSDR 1990b). Copper in the  $\text{Cu}^{++}$  valence state forms compounds and complexes with a variety of organic and inorganic ligands binding to  $-\text{NH}_2$ ,  $-\text{SH}$ , and, to a lesser extent,  $-\text{OH}$  groups (ATSDR 1990b). The predominant form of copper in aqueous solution is dependent on the pH of the solution. Below pH 6, the cupric ion ( $\text{Cu}^{++}$ )

predominates; copper complexes with carbonate usually predominate above pH 6 (U.S. EPA 1987a; ATSDR 1990b). The association of copper with organic or inorganic ligands also depends on the pH and on the  $\text{CaCO}_3$  alkalinity. Rivers in the northwestern U.S. with a relatively high pH (7.0-8.5) and 24-219 ppm  $\text{CaCO}_3$  were found to contain copper associated primarily with  $\text{CO}_3^{2-}$  and  $\text{OH}^-$  ions. Under these conditions, copper can precipitate as malachite ( $\text{Cu}_2(\text{OH})_2\text{CO}_3$ ). Copper was found to be largely associated with organic matter in lakes and rivers with a lower pH (4.6-6.3) and  $\text{CaCO}_3$  concentration (1-30 ppm) such as found in southern Maine (ATSDR 1990b).

Most of the copper entering surface water is in the form of particulate matter, which settles out, precipitates, or adsorbs to organic matter, hydrous iron and manganese oxides, and clay; however, the predominating form can change with the amount of rain, pH, content of runoff, and the availability of ligands (ATSDR 1990b). The processes of complexation, adsorption and precipitation limit the concentration of copper ( $\text{Cu}^{++}$ ) to very low values in most natural waters (ATSDR 1990b). Copper discharged into a river upstream from the Chesapeake Bay was measured at 53 ppb. Copper associated with particulate material that were settleable solids accounted for 36 ppb. The copper concentration decreased rapidly downstream to 7 ppb 2-3 km from the pollution source. The copper concentration in the settlement, however, was 10 times the concentration in uncontaminated areas (ATSDR 1990b).

4. Biota — Calculations of the bioconcentration factor in fish for copper have ranged from 10 to 100; however, the majority of copper measurements in fish tissues under environmental conditions have indicated little, if any, bioconcentration. The copper content of fish muscle tissue taken from copper-contaminated lakes near Sudbury, Ontario were found to contain about the same level of copper as fish from uncontaminated areas (ATSDR 1990b). Filter feeding shellfish, especially oysters, however, were found to significantly concentrate copper with bioconcentration factors as high as 30,000 (ATSDR 1990b).

## CHEMICAL SUMMARY FOR DIETHYLENE GLYCOL MONOETHYL ETHER ACETATE

This chemical was identified by one or more suppliers as a bath ingredient for the conductive ink process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of diethylene glycol monoethyl ether acetate (DGEEA) are summarized below. In the body, glycol ether esters are apparently saponified (hydrolyzed) to the parent glycol ether and an organic acid. Systemic effects of the esters are typical of those of the corresponding parent glycol ethers (HSDB 1996), which for DGEEA, is diethylene glycol monoethyl ether (DGEE). Therefore, this report will also provide information on DGEE.

**CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF DGEEA**

Characteristic/Property	Data	Reference
CAS No.	112-15-2	
Common Synonyms	DGEEA; 2-(2-ethoxyethoxy)ethanol acetate; Carbitol® acetate	Gingell et al. 1994
Molecular Formula	C <sub>8</sub> H <sub>16</sub> O <sub>4</sub>	Gingell et al. 1994
Chemical Structure	C <sub>2</sub> H <sub>5</sub> OCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>2</sub> OOCCCH <sub>3</sub>	Gingell et al. 1994
Physical State	colorless liquid; hygroscopic	HSDB 1996
Molecular Weight	176.2	
Melting Point	-11°C, -25°C	Verschuere 1996
Boiling Point	217.4°C @ 760 mm Hg	Gingell et al. 1994
Water Solubility	miscible	HSDB 1996
Density	specific gravity (25/4°C), 1.01	Gingell et al. 1994
Vapor Density (air = 1)	6.07	Gingell et al. 1994
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	not found	
Vapor Pressure	0.05 mm Hg @ 25°C	Gingell et al. 1994
Reactivity	not found	
Flammability	must be preheated before ignition	HSDB 1996
Flash Point	open cup, 225°F (107°C)	HSDB 1996
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	50% recognition, 0.157 ppm 100% recognition, 0.263 ppm	Verschuere 1996
Conversion Factors	1 ppm ≈ 7.20 mg/m <sup>3</sup> @ 25°C, 760 mm Hg 1 mg/m <sup>3</sup> ≈ 0.1389 ppm	Gingell et al. 1994

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of DGEEA. The ester probably enters the environment as does its parent ether, DGEE, i.e., via effluents from sites where it is produced or used as a solvent and from other industries (Howard 1993). In a national survey of wastewater effluents, DGEE occurred in 5 of 21 industrial categories (Howard 1993). Average concentrations of DGEE in wastewater from various industries were as follows: 497 mg/L (iron and steel); 52,189 mg/L (printing and publishing); 175 mg/L (amusement and athletic goods); and 40 mg/L (pulp and paper) (Howard 1993). DGEE has also been found in

effluents from publicly-owned treatment works (Howard 1993). A drinking-water survey identified DGEE as a contaminant in 11 U.S. cities and 1 county (Howard 1993).

## B. Transport

The low vapor pressure of DGEEA (0.05 mm Hg [Gingell et al. 1994]) suggests that volatilization from soil or water will not be a significant transport mechanism for the chemical. DGEEA is miscible with water and may move through the soil, possibly to groundwater.

The parent ether, DGEE, is also miscible with water and has an estimated Henry's Law Constant of  $8.63 \times 10^{-10}$  atm-m<sup>3</sup>/mole at 25°C (Howard 1993). This indicates that volatilization from natural bodies of water and moist soils should not be a significant fate process for the ether. The calculated K<sub>OC</sub> value (20) for DGEE indicates that the chemical will be highly mobile in soil and should not partition from the water column to organic matter in sediments and suspended solids (Howard 1993).

## C. Transformation/Persistence

No information was found in the secondary sources searched regarding the transformation/persistence of DGEEA in the environment. However, inferences can be drawn regarding the fate of DGEEA, based on the following data for its parent ether, DGEE.

1. Air — DGEE in ambient air exists mostly in the vapor phase (Howard 1993). The putative removal mechanisms for atmospheric DGEE are vapor phase reactions with photochemically produced hydroxyl radicals (Howard 1993). The estimated rate constant of  $2.93 \times 10^{-11}$  cm<sup>3</sup>/molecule-sec @ 25°C for DGEE corresponds to a half-life of about 13 hours, assuming the atmospheric concentration of hydroxyl radicals is  $5 \times 10^5$  per cm<sup>3</sup> (Howard 1993). Wet deposition of DGEE is limited by its short residence time (Howard 1993).
2. Soil — The results of aqueous screening tests indicate that biodegradation is the most significant mechanism for the removal of DGEE from aerobic soil (see the results of screening tests in section II.C.3) (Howard 1993). Hydrolysis and direct photolysis are not important mechanisms for the removal of DGEE from soil (Howard 1993).
3. Water — The results of aqueous screening tests indicate that biodegradation is the primary mechanism for the removal of DGEE from water (Howard 1993). After 16 days of acclimation, losses of 39.8% and 34.3% were recorded using an 8-hour Warburg test and a 5-day BOD (biochemical oxygen demand) test, respectively (Howard 1993). In two assays conducted without acclimation, the BODT values after 20-day incubation periods were 48 and 87% (Howard 1993). Using the Zahn-Wellens screening method, a >90% loss of the original concentration of DGEE (400 ppm) occurred in 28 days (Howard 1993). DGEE should not undergo hydrolysis or direct photolysis in the aquatic environment (Howard 1993).
4. Biota — The calculated log BCF (bioconcentration factor) of -0.34 for DGEE and its miscibility with water indicate that the chemical will not bioconcentrate in aquatic organisms (Howard 1993).

## CHEMICAL SUMMARY FOR DIETHYLENE GLYCOL METHYL ETHER

This chemical was identified by one or more suppliers as a bath ingredient for the conductive ink process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of diethylene glycol methyl ether are summarized below.

## CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF DIETHYLENE GLYCOL METHYL ETHER

Characteristic/Property	Data	Reference
CAS No.	111-77-3	
Common Synonyms	2-(2-methoxyethoxy) ethanol, methyl carbitol, MECB, Dowanol DM, DGME	HSDB 1995 CHEMFATE 1995
Molecular Formula	C <sub>5</sub> H <sub>12</sub> O <sub>3</sub>	
Chemical Structure	CH <sub>3</sub> OCH <sub>2</sub> OCH <sub>2</sub> CH <sub>2</sub> OH	
Physical State	colorless liquid	HSDB 1995
Molecular Weight	120.15	CHEMFATE 1995
Melting Point	< -84 °C	HSDB 1995
Boiling Point	193 °C	HSDB 1995
Water Solubility	completely miscible	U.S. EPA 1984b
	1 x 10 <sup>6</sup> mg/L at 25 °C	CHEMFATE 1995
Density	d <sub>20</sub> <sup>4</sup> , 1.035	HSDB 1995
Vapor Density (air = 1)	4.14	HSDB 1995
K <sub>OC</sub>	10	HSDB 1995
Log K <sub>OW</sub>	-0.68 (calculated)	CHEMFATE 1995
	-0.79 - -0.93	U.S. EPA 1984b
Vapor Pressure	0.18 mm Hg at 25 °C	CHEMFATE 1995
Reactivity	can react with oxidizing materials	HSDB 1995
Flammability	moderate when exposed to heat or flame	HSDB 1995
Flash Point	200 °F (93 °C)	HSDB 1995
Dissociation Constant	no data	
Henry's Law Constant	6.5 x 10 <sup>-10</sup> atm-cm <sup>3</sup> /mole at 25 °C	HSDB 1995
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Log Bioconcentration Factor	-0.75 (estimated)	HSDB 1995
Odor Threshold	no data; mild, pleasant	HSDB 1995
Conversion Factors	1 ppm = 4.91 mg/m <sup>3</sup>	
	1 mg/m <sup>3</sup> = 0.204 ppm	HSDB 1995

## II. ENVIRONMENTAL FATE

## A. Environmental Release

No information was found regarding the quantity of diethylene glycol methyl ether (DGME) released to the environment. The chemical has been identified as a contaminate in drinking water samples (concentrations not listed) from cities across the continental U.S. (HSDB 1995). An average concentration of 3571 mg/L was found in the wastewater from paint and ink industries (HSDB 1995).

## B. Transport

Because of the high water solubility and low Henry's Law Constant, most of the DGME released to the environment should end up in aquatic environments. The low K<sub>OC</sub> indicates that the chemical can leach into ground water from soils; volatilization from water and soils is not an

important transport process (HSDB 1995). Removal from the atmosphere in precipitation is possible (HSDB 1995).

**C. Transformation/Persistence**

1. Air — DGME should not undergo direct photolysis. The reaction rate constant with hydroxyl radicals has been estimated to be  $2.44 \times 10^{-11}$  cm<sup>3</sup>/molecule-sec and corresponds to an atmospheric half-life of about 16 hours (HSDB 1995).
2. Soil — In general, biodegradation and leaching would be the most important removal processes for glycol ethers in soils (U.S. EPA 1984b).
3. Water — DGME was degraded by 0, 21, and 66% after 5, 10, and 20 days respectively when settled waste water or sewage sludge was used as inoculum (HSDB 1995).
4. Biota — Based on the high water solubility and low estimated bioconcentration factor of DGME, the chemical would not be expected to bioconcentrate in aquatic animals (HSDB 1995).

## CHEMICAL SUMMARY FOR DIETHYLENE GLYCOL N-BUTYL ETHER

This chemical was identified by one or more suppliers as a bath ingredient for the conductive ink process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of diethylene glycol n-butyl ether are summarized below.

## CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF DIETHYLENE GLYCOL N-BUTYL ETHER

Characteristic/Property	Data	Reference
CAS No.	112-34-5	
Common Synonyms	diethylene glycol monobutyl ether; butyl carbitol	Budavari et al. 1989
Molecular Formula	C <sub>8</sub> H <sub>18</sub> O <sub>3</sub>	Budavari et al. 1989
Chemical Structure	HOCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>2</sub> OC <sub>4</sub> H <sub>9</sub>	Budavari et al. 1989
Physical State	liquid	Budavari et al. 1989
Molecular Weight	162.22	Budavari et al. 1989
Melting Point	-68°C	Budavari et al. 1989
Boiling Point	230.4°C	Budavari et al. 1989
Water Solubility	1 x 10 <sup>6</sup> mg/L at 25°C	CHEMFATE 1995
Density	0.9536	Budavari et al. 1989
Vapor Density (air = 1)	5.58	Gingell et al. 1994
K <sub>oc</sub>	75 (calculated)	HSDB 1995
Log K <sub>ow</sub>	0.91 (calculated)	CHEMFATE 1995
Vapor Pressure	0.0219 mm Hg at 25°C	CHEMFATE 1995
Reactivity	non reactive; NFPA rating: 0.0	HSDB 1995
Flammability	must be heated	HSDB 1995
Flash Point	500°F	Gingell et al. 1994
Dissociation Constant	no data	
Henry's Law Constant	1.52 x 10 <sup>-9</sup> atm-m <sup>3</sup> /mole at 25°C	HSDB 1995
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	2.88 (estimated)	HSDB 1995
Odor Threshold	practically odorless	Budavari et al. 1989
Conversion Factors	1 ppm = 6.63 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.15 ppm	Gingell et al. 1994

## II. ENVIRONMENTAL FATE

## A. Environmental Release

In 1993 as reported to the TRI by certain types of U.S. industries, environmental releases of all glycol ethers totaled 45.9 million pounds; diethylene glycol n-butyl ether is not reported separately (TRI93 1995). The chemical has been detected in the waste water effluents from industries at average concentrations ranging from 7 to 244 mg/L (HSDB 1995).

## B. Transport

Because of its miscibility with water, diethylene glycol n-butyl ether will partition to the water column and be highly mobile in soils. In the atmosphere, the chemical may be removed by precipitation and dissolution in clouds (HSDB 1995).

**C. Transformation/Persistence**

1. Air — In the atmosphere, diethylene glycol n-butyl ether should exist almost entirely in the vapor phase. The estimated half-life for reaction with hydroxyl radical is 11 hours (HSDB 1995).
2. Soil — Diethylene glycol n-butyl ether should partition to the water column of moist soils and volatilization will not be significant (HSDB 1995).
3. Water — Diethylene glycol n-butyl ether is not expected to undergo hydrolysis and the Henry's Law Constant indicates that volatilization would be slow. However, aerobic biodegradation may be an important removal mechanism from aquatic systems (HSDB 1995). No other information was found.
4. Biota — Based on the estimated bioconcentration factor of 2.88 (HSDB 1995), diethylene glycol n-butyl ether should not bioaccumulate in aquatic organisms.



## APPENDIX C

### CHEMICAL SUMMARY FOR *N,N*-DIMETHYLFORMAMIDE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online data bases, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

#### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of *N,N*-dimethylformamide are summarized below.

##### CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF *N,N*-DIMETHYLFORMAMIDE

Characteristic/Property	Data	Reference
CAS No.	68-12-1	
Common Synonyms	DMF; DMFA; dimethylformamide; <i>N,N</i> -dimethylmethanamide; <i>N</i> -formyldimethylamine	IARC 1989
Molecular Formula	C <sub>3</sub> H <sub>7</sub> NO	Budavari et al. 1989
Chemical Structure	HCON(CH <sub>3</sub> ) <sub>2</sub>	Budavari et al. 1989
Physical State	colorless to slightly yellow liquid	Budavari et al. 1989
Molecular Weight	73.09	Budavari et al. 1989
Melting Point	-61°C	Budavari et al. 1989
Boiling Point	153°C @ 760 mm Hg	Budavari et al. 1989
Water Solubility	miscible with water	Budavari et al. 1989
Density	0.9445 @ 25/4°C	Budavari et al. 1989
Vapor Density (air = 1)	2.51	Verschueren 1983
K <sub>oc</sub>	7 (calculated)	HSDB 1996
Log K <sub>ow</sub>	-1.01	CHEMFATE 1996
Vapor Pressure	3.87 mm Hg @ 25°C	CHEMFATE 1996
Reactivity	can react vigorously with oxidizing agents, halogenated hydrocarbons, and inorganic nitrates; pH of 0.5 molar soln. = 6.7	HSDB 1996; Budavari et al. 1989
Flammability	combustible	HSDB 1996
Flash Point	67°C (153°F) (open cup)	Budavari et al. 1989
Dissociation Constant	0.3	CHEMFATE 1996
Air Diffusivity Constant	no data	
Molecular Diffusivity Constant	no data	
Henry's Law Constant	7.39 X 10E-8 atm-m <sup>3</sup> /mole @ 25°C	HSDB 1996
Fish Bioconcentration Factor	-1.01 (log; calculated)	HSDB 1996
Odor Threshold	0.14 mg/m <sup>3</sup> (nonperception); 0.88 mg/m <sup>3</sup> (perception); fishy odor	Verschueren 1983
Conversion Factors	1 ppm = 3.04 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.33 ppm	Verschueren 1983

#### II. ENVIRONMENTAL FATE

##### A. Environmental Release

*N,N*-Dimethylformamide is a widely used solvent for organic compounds where a low rate of evaporation is required. The chemical may be emitted to the environment by effluents from a variety of petrochemical industries (Howard 1993).

*N,N*-Dimethylformamide has been identified in the air over a hazardous waste site in Lowell, MA and a neighboring industry at concentrations of 2.18 and >50 ppb, respectively; in 1 of 63 industrial wastewater effluents (<10 µg/L); and in waste effluent of a plastics manufacturer (28,378 ng/µL extract). The chemical was listed as a contaminant found in drinking water

samples in several U.S. cities, and in 1 of 204 samples in a national survey of surface waters (Howard 1993).

## B. Transport

Volatilization of *N,N*-dimethylformamide from land or water is not expected to be significant (Howard 1993). The complete water solubility suggests that the chemical can be removed from the atmosphere by rainfall. *N,N*-dimethyl-formamide is expected to be highly mobile in soils and will probably leach into groundwater (U.S. EPA 1986).

## C. Transformation/Persistence

1. Air — Based upon the vapor pressure (3.87 mm Hg @ 25°C), *N,N*-dimethyl-formamide is expected to exist almost entirely in the gaseous phase in the atmosphere. The vapor phase reaction of *N,N*-dimethylformamide with photochemically produced hydroxyl radicals is likely to be an important fate process. The rate constant for the vapor phase reaction with photochemically produced hydroxyl radicals is estimated to be  $2.24 \times 10^{-10}$  cm<sup>3</sup>/molecule-sec at 25°C, which corresponds to an atmospheric half-life of about 2 hours (Howard 1993). In smog chamber studies, *N,N*-dimethylformamide was relatively nonreactive with regard to photochemical oxidant formation (U.S. EPA 1986).
2. Soil — The calculated  $K_{oc}$  of 7 indicates that *N,N*-dimethylformamide will be highly mobile in soils and the Henry's Law Constant ( $7.39 \times 10E^{-8}$  atm-m<sup>3</sup>/mole) suggests that volatilization from soils will not be important (Howard 1993). Aqueous screening and a river die-away test suggests that biodegradation of *N,N*-dimethylformamide in soil will be rapid (HSDB 1996). When wastewater containing 250 mg/L *N,N*-dimethylformamide was aerobically treated with activated sludge, 95% of the chemical was degraded in 18 hours (U.S. EPA 1986).
3. Water — The estimated  $K_{oc}$  (ranging in the high mobility class for soil) indicates that *N,N*-dimethylformamide will not partition from the water column to organic matter contained in the sediments and suspended solids. The Henry's Law Constant suggests that volatilization from environmental waters will not be important (Howard 1993). *N,N*-Dimethylformamide hydrolyzes slowly in neutral pH water, but hydrolysis is accelerated by acids and bases (U.S. EPA 1986). *N,N*-Dimethylformamide can be biodegraded by activated sludge, although an acclimation period is usually required. River die-away data suggest that the biodegradation of the chemical should be rapid (Howard 1993).
4. Biota — The bioconcentration factor of -1.01 (log) indicates that *N,N*-dimethyl-formamide will not bioconcentrate in aquatic organisms (Howard 1993).

## CHEMICAL SUMMARY FOR ETHANOLAMINE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, carbon, graphite, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of ethanolamine are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF ETHANOLAMINE		
Characteristic/Property	Data	Reference
CAS No.	141-43-5	
Common Synonyms	2-amino-1-ethanol; monoethanolamine; 2-hydroxyethylamine; beta-aminoethanol; glycinol; MEA	HSDB 1995
Molecular Formula	C <sub>2</sub> H <sub>7</sub> NO	Budavari et al. 1989
Chemical Structure	HOCH <sub>2</sub> CH <sub>2</sub> NH <sub>2</sub>	Benya and Harbison 1994
Physical State	viscous hygroscopic liquid	Budavari et al. 1989
Molecular Weight	61.08	Budavari et al. 1989
Melting Point	10.3°C	Budavari et al. 1989
Boiling Point	170.8°C @ 760 mm Hg	Budavari et al. 1989
Water Solubility	completely soluble	Benya and Harbison 1994 Density
	1.0117 @ 25/4°C	Budavari et al. 1989
Vapor Density (air = 1)	2.1	HSDB 1995
K <sub>oc</sub>	5	HSDB 1995
Log K <sub>ow</sub>	-1.31	CHEMFATE 1995
Vapor Pressure	0.26 mm Hg at 25°C	HSDB 1995
Reactivity	reacts with strong oxidizers, strong acids, iron; may attack copper, brass, rubber; pH = 12.1 (0.1 N aqueous solution); single or double substitution of the amine group leads to formation of a variety of compounds	NIOSH 1994
Flammability	2 (liquid which must be moderately heated before ignition will occur)	Budavari et al. 1989
Flash Point	85°C, closed cup; 93.33°C open cup	Benya and Harbison 1994
Air Diffusion Coefficient	no data	HSDB 1995
Dissociation Constant	9.4994	ACGIH 1991
Molecular Diffusivity Coefficient	no data	CHEMFATE 1995
Henry's Law Constant	4xE-8 atm-m <sup>3</sup> /mole @ 25°C	CHEMFATE 1995
Fish Bioconcentration Factor	<1 (calculated)	HSDB 1995
Odor Threshold	3-4 ppm	ACGIH 1991
Conversion Factors	1 ppm = 2.54 mg/m <sup>3</sup> ; 1 mg/m <sup>3</sup> = 0.39 ppm	Verschueren 1983

## II. ENVIRONMENTAL FATE

## A. Environmental Release

Ethanolamine is a colorless viscous liquid with an unpleasant, fishy, ammoniacal odor (Budavari et al. 1989; Grant 1986). It is released to the environment primarily from emissions and effluents from sites of industrial production or use, from disposal of consumer products containing ethanolamine such as cleaning products, and use of agricultural products in which it is used as a dispersing agent. Ethanolamine can also be released to the environment in urine. Ethanolamine was one of the primary amines identified in aerosol samples collected over the North Atlantic Ocean. Highest concentrations were found in samples taken near North America,

Bermuda, the Azores, and in the Arctic Circle, and low concentrations in the Gulf stream and in the equatorial North Atlantic (Gorzelska and Galloway 1990, as reported in TOXLINE).

## **B. Transport**

Ethanolamine is completely soluble in water (Benya and Harbison 1994), and if released to the soil, would not be expected to adsorb appreciably to organic material [calculated  $K_{OC} = 5$  (HSDB 1995)]. Ethanolamine has the potential to leach into groundwater. The volatilization of ethanolamine from water is believed to be negligible [Henry's Law constant =  $4E-8$  atm-m<sup>3</sup>/mole @ 25°C (CHEMFATE 1995)].

## **C. Transformation/Persistence**

1. Air — The dominant removal mechanism is expected to be reaction with photochemically generated hydroxyl radicals. The calculated half-life for ethanolamine vapor reacting with hydroxyl radicals is 11 hours. The complete water solubility of ethanolamine suggests that this compound may also be removed from the atmosphere in precipitation (HSDB 1995).
2. Soil — If released to soil, ethanolamine is expected to biodegrade fairly rapidly following acclimation and to leach in soil. The half-life is on the order of days to weeks. Volatilization from soil surfaces is not expected to be an important removal process (HSDB 1995).
3. Water — If released to water, ethanolamine is expected to undergo biodegradation. The half-life of this compound may range from a few days to a few weeks depending, in large part, on the degree of acclimation of the system. Bioconcentration in aquatic organisms, adsorption to suspended solids and sediments, and volatilization are not important removal processes (HSDB 1995). Tests utilizing settled sewage seed showed that 0%, 58.4%, or 75% of added compound was biodegraded after 5, 10, or 50 days, respectively. In a closed activated sludge system, 93.6% of the added chemical was biodegraded (CHEMFATE 1995).
4. Biota — The bioconcentration factor of <1 (based on a log  $K_{OW}$  of -1.31) and the complete water solubility of ethanolamine suggest that the compound does not bioconcentrate in aquatic organisms (HSDB 1995).

## CHEMICAL SUMMARY FOR ETHYLENE GLYCOL

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper and carbon processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of ethylene glycol are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF ETHYLENE GLYCOL		
Characteristic/Property	Data	Reference
CAS No.	107-21-1	
Common Synonyms	1,2-ethanediol, 1,2-dihydroxyethane	CHEMFATE 1995
Molecular Formula	C <sub>2</sub> H <sub>6</sub> O <sub>2</sub>	CHEMFATE 1995
Chemical Structure	HOCH <sub>2</sub> CH <sub>2</sub> OH	Budavari et al. 1989
Physical State	slightly viscous liquid	Budavari et al. 1989
Molecular Weight	62.07	Budavari et al. 1989
Melting Point	-13°C	Budavari et al. 1989
Boiling Point	197.6°C at 760 mm Hg	Budavari et al. 1989
Water Solubility	miscible absorbs twice its weight of water at 100% relative humidity	CHEMFATE 1995 Budavari et al. 1989
Density	d <sub>20</sub> <sup>4</sup> , 1.114	Budavari et al. 1989
Vapor Density (air = 1)	2.14	Verschuereen 1983
K <sub>OC</sub>	4 (calculated)	CHEMFATE 1995
Log K <sub>OW</sub>	-1.36	CHEMFATE 1995
Vapor Pressure	0.092 mm Hg at 25°C	CHEMFATE 1995
Reactivity	reacts violently with chlorosulfonic acid, sulfuric acid, and oleum	Keith and Walters 1985
Flammability	combustible	Keith and Walters 1985
Flash Point	115°C (open cup)	Budavari et al. 1989
Dissociation Constant	15.1	CHEMFATE 1995
Molecular Diffusivity Constant	no data	
Air Diffusivity Constant	no data	
Henry's Law Constant	6.0 x 10 <sup>-8</sup> atm-m <sup>3</sup> /mole	CHEMFATE 1995
Fish Bioconcentration Factor	10 ( <i>Leucisius idus melanotus</i> , golden ide)	CHEMFATE 1995
Odor Threshold	odorless	ATSDR 1993a
Conversion Factors	1 ppm = 2.58 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.39 ppm	Verschuereen 1983

## II. ENVIRONMENTAL FATE

## A. Environmental Release

In 1992 as reported to the TRI by certain types of U.S. industries, a total of 17.2 million pounds of ethylene glycol was released to the environment. The total consisted of 10.25 million pounds released to the atmosphere, 6.25 million pounds to ground and surface waters, and 0.7 million pounds to land (TRI92 1994). The major source of ethylene glycol in the environment is the disposal of used antifreeze. The chemical was found in concentrations of <0.05-0.33 mg/m<sup>3</sup> as aerosol and <0.05-10.4 mg/m<sup>3</sup> as vapor in ambient air samples collected above bridges following spray application of a deicing fluid containing 50% ethylene glycol (ATSDR 1993a).

## B. Transport

The low Henry's Law Constant and high water solubility indicate that ethylene glycol will not volatilize from surface waters. Based on the calculated K<sub>OC</sub> the chemical is expected to be

highly mobile in soils and can leach into ground waters; however, ethylene glycol is readily biodegraded (ATSDR 1993a; U.S. Air Force 1989a). Removal from the atmosphere in rainfall is possible (ATSDR 1993a).

**C. Transformation/Persistence**

1. Air — The half-life for reaction of ethylene glycol with hydroxy radicals in the atmosphere is 2.1 days (CHEMFATE 1995). Estimated half-lives for photochemical oxidation range from 24 to 50 hours (ATSDR 1993a).
2. Soil — Several genera of soil microbes have been shown to completely degrade concentrations of 1-3% ethylene glycol within 3 days (ATSDR 1993a). *Clostridium glycolicum*, isolated from mud, degraded the chemical under anaerobic conditions (concentration and time not given) (CHEMFATE 1995).
3. Water — Biodegradation of ethylene glycol has been demonstrated by acclimated and unacclimated microorganisms from a variety of aqueous media (ATSDR 1993; U.S. Air Force 1989a). Complete degradation occurred with activated sewage sludge in approximately 80 hours (CHEMFATE 1995). Several *Mycobacterium* sp. and *Alcaligenes* sp. are capable of utilizing ethylene glycol as a sole carbon source (CHEMFATE 1995). In contrast, the half-life for reaction with hydroxy radicals in aqueous solution has been calculated as 2.84 years (CHEMFATE 1995).
4. Biota — The high water solubility, rapid microbial degradation, and low to moderate bioconcentration factor indicate that ethylene glycol would not be expected to bioaccumulate in aquatic organisms.

## CHEMICAL SUMMARY FOR ETHYLENEDIAMINE TETRAACETIC ACID (EDTA)

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of EDTA are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF EDTA		
Characteristic/Property	Data	Reference
CAS No.	60-00-4	
Common Synonyms	acetic acid, (ethylenedinitrilo)-tetra-; edetic acid; EDTA; EDTA acid; Trilon BW; Versene	HSDB 1995
Molecular Formula	$C_{10}H_{16}N_2O_8$	
Chemical Structure		
Physical State	colorless crystals	HSDB 1995
Molecular Weight	292.28	HSDB 1995
Melting Point	decomposes @ 240°C	HSDB 1995
Boiling Point	not found	
Water Solubility	0.5 g/L @ 25°C	Budavari et al. 1989
Density	not found	
Vapor Density (air = 1)	not found	
$K_{oc}$	not found	
Log $K_{ow}$	not found	
Vapor Pressure	not found	
Reactivity	chelates di- and tri-valent metals	HSDB 1995
Flammability	may burn, but does not ignite readily	HSDB 1995
Flash Point	not found	
Dissociation Constant	0.26 (measured)	CHEMFATE 1995
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	<2 (bluegill, measured) 19 (@ 25°C, calculated)	HSDB 1995
Odor Threshold	not found	
Conversion Factors	1 ppm = 11.9 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.084 ppm	Calculated using: mg/m <sup>3</sup> x 24.45/m.w.

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

EDTA does not occur naturally in the environment (HSDB 1995). The main sources of EDTA released to the environment are probably domestic sewage and industrial effluents, resulting from the chelating applications of the chemical (HSDB 1995). Other sources of release of the chemical include the use of herbicides and the land disposal of products that contain EDTA (HSDB 1995).

In 1974 in England, concentrations of EDTA ranging from 0 to 1120 ppb were detected in the Lea River and concentrations ranging from 200 to 1200 ppb were detected in the effluent from the Rye Meads sewage treatment plant (HSDB 1995). In other studies, EDTA concentrations of 100 to 550 ppb were detected in sewage effluents (no other details were available) (Verschueren 1983). Other monitoring data were not found in the secondary sources searched.

**B. Transport**

Under environmental conditions (pH 5-10), EDTA completely dissociates, as is indicated by  $pK_{a1} = 0.26$ ,  $pK_{a2} = 0.96$ ,  $pK_{a3} = 2.60$  and  $pK_{a4} = 2.76$  (HSDB 1995). This suggests that volatilization from water or soil would not be significant for EDTA. A study of EDTA degradation in soils detected no volatilization (HSDB 1995).

EDTA and complexes of EDTA with alkaline earth metals and trace metals demonstrate negligible adsorption to silica, humic acid, kaolin, kaolinite (EDTA only), river sediments, and humus solids (HSDB 1995). According to at least one report, EDTA leaches readily in soil (HSDB 1995).

**C. Transformation/Persistence**

1. Air — EDTA released to the atmosphere may undergo direct photolysis or may react with photochemically-generated hydroxyl radicals (HSDB 1995). The estimated half-life for the reaction of EDTA vapor with photochemically generated hydroxyl radicals in the atmosphere is 3.01 days (HSDB 1995).
2. Soil — EDTA released to the soil is expected to complex with trace metals and alkaline earth metals that occur in the soil, increasing their total solubility (HSDB 1995). Eventually, EDTA may exist predominantly as the Fe(III) chelate in acidic soils and as the Ca chelate in alkaline soils (HSDB 1995).  
Biodegradation is the predominant removal mechanism for EDTA in aerobic soils, whereas biodegradation of the chemical is negligible in anaerobic soils (HSDB 1995). Mineralization values for 2-4 ppm EDTA in various soils range from 13 to 45% after 15 weeks and from 65 to 70% after 45 weeks (HSDB 1995).
3. Water — EDTA released to water is expected to complex with trace metals and alkaline earth metals (HSDB 1995). In water under aerobic conditions, EDTA undergoes biodegradation relatively slowly. As in soil, the anaerobic biodegradation of EDTA in water is negligible (HSDB 1995). Possible biodegradation products of the ammonium ferric chelate of EDTA include the following: ethylenediamine triacetic acid (ED3A), iminodiacetic acid (IDA), N,N-ethylenediamine diacetic acid (N,N-EDDA), N,N'-EDDA, ethylenediamine monoacetic acid (EDMA), nitrilotriacetic acid (NTA) and glycine (HSDB 1995).  
In water, EDTA may react with photochemically-generated hydroxyl radicals (half-life, 229 days) or undergo photodegradation. In an aqueous solution, the Fe(III) complex of EDTA degraded with a half-life of 11.3 minutes when exposed to artificial sunlight (HSDB 1995). The following were photodegradation products of Fe(III)-EDTA: carbon monoxide, formaldehyde, ED3A, N,N-EDDA, N,N'-EDDA, IDA, EDMA and glycine (HSDB 1995).
4. Biota — The fish bioconcentration factors for EDTA (<2 and 19) suggest that the chemical will not bioaccumulate in aquatic organisms (HSDB 1995). It is not expected to adsorb to suspended solids or sediments (HSDB 1995).



## CHEMICAL SUMMARY FOR FLUOROBORIC ACID (FLUORIDE)

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources. Very little information on the environmental fate and toxicity of fluoroboric acid or fluoroborates was found in the available secondary sources. Supplemental information is provided for fluoride which may be a degradation product and for sodium bifluoride.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of fluoroboric acid are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF FLUOROBORIC ACID		
Characteristic/Property	Data	Reference
CAS No.	16872-11-0	HSDB 1995
Common Synonyms	hydrogen tetrafluoroborate	HSDB 1995
	fluoboric acid	
	hydrofluoroboric acid	
Molecular Formula	HB <sub>4</sub>	HSDB 1995
Chemical Structure	B-F <sub>4</sub> -H	Fisher Scientific 1993
Physical State	colorless liquid	HSDB 1995
Molecular Weight	87.82	HSDB 1995
Melting Point	-90°C	Fisher Scientific 1993
Boiling Point	130°C (decomposes)	HSDB 1995
Water Solubility	miscible;	HSDB 1995
	sol. in hot water	
Density	~1.84 g/mL	HSDB 1995
K <sub>oc</sub>	NA	
Log K <sub>ow</sub>	NA	
Vapor Pressure	5.1 mm Hg at 20°C	Fisher Scientific 1993
Vapor Density	3.0	Fisher Scientific 1993
Reactivity	strong acid; corrosive	HSDB 1995
Flammability	NA	
Flash Point	NA	
Dissociation Constant (-pK)	-4.9	HSDB 1995
Henry's Law Constant	NA	
Molecular Diffusivity Coefficient	NA	
Air Diffusivity Coefficient	NA	
Fish Bioconcentration Factor	NA	
Odor Threshold	NA	
Conversion Factors	NA	

The chemical identity and physical/chemical properties of sodium tetrafluoroborate are summarized below.

## CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM TETRAFLUOROBORATE

Characteristic/Property	Data	Reference
CAS No.	013755-29-8	Lockheed Martin 1994a
Common Synonyms	sodium fluoroborate STB sodium borfluoride sodium boron tetrafluoride	Lockheed Martin 1994a
Molecular Formula	NaNF <sub>4</sub>	
Chemical Structure	Na-F <sub>4</sub> -B	
Physical State	white crystalline powder	Sigma-Aldrich 1992
Molecular Weight	109.82	Budavari et al. 1989
Melting Point	384 °C	Budavari et al. 1989
Boiling Point		
Water Solubility	108 g/100 mL at 26 °C 210 g/100 mL at 100 °C	Budavari et al. 1989
Density	2.470	Sigma-Aldrich 1992
K <sub>oc</sub>	NA	
Log K <sub>ow</sub>	NA	
Vapor Pressure	NA	
Reactivity	reacts with strong oxidizing agents; sensitive to moisture	Sigma-Aldrich 1992
Flammability	noncombustible	Lockheed Martin 1994a
Flash Point	NA	
Dissociation Constant (-pK)	NA	
Henry's Law Constant	NA	
Molecular Diffusivity Coefficient	NA	
Air Diffusivity Coefficient	NA	
Fish Bioconcentration Factor	NA	
Odor Threshold	NA	
Conversion Factors	NA	

The chemical identity and physical/chemical properties of sodium fluoride are summarized below.

## CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM FLUORIDE

Characteristic/Property	Data	Reference
CAS No.	7681-49-4	
Common Synonyms	sodium hydrofluoride sodium monfluoride floridine	
Molecular Formula	NaF	
Chemical Structure	Na-F	
Physical State	crystals	Budavari et al. 1989
Molecular Weight	42.00	Budavari et al. 1989
Melting Point	993 °C	Budavari et al. 1989
Boiling Point	1704 °C	Budavari et al. 1989
Water Solubility	4.0 g/100 mL at 15 °C 4.3 g/100 mL at 25 °C	Budavari et al. 1989
Density	2.78	Budavari et al. 1989
K <sub>oc</sub>	NA	
Log K <sub>ow</sub>	NA	
Vapor Pressure	1 mm Hg at 1077 °C	Keith and Walters 1985
Reactivity	stable under normal conditions	Keith and Walters 1985
Flammability	nonflammable	Keith and Walters 1985
Flash Point	NA	
Dissociation Constant (-pK)	NA	
Henry's Law Constant	NA	
Molecular Diffusivity Coefficient	NA	
Air Diffusivity Coefficient	NA	
Fish Bioconcentration Factor	NA	
Odor Threshold	NA	
Conversion Factors	NA	

The chemical identity and physical/chemical properties of sodium bifluoride are summarized below.

## APPENDIX C

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM BIFLUORIDE		
Characteristic/Property	Data	Reference
CAS No.	1333-83-1	HSDB 1995
Common Synonyms	sodium hydrogen difluoride sodium hydrogen fluoride sodium acid fluoride	HSDB 1995
Molecular Formula	NaHF <sub>2</sub>	Lewis 1993
Chemical Structure	F <sub>2</sub> -H-Na	HSDB 1995
Physical State	white, crystalline powder	Budavari et al. 1989
Molecular Weight	62.01	Budavari et al. 1989
Melting Point	decomposes on heating	Lewis 1993
Boiling Point	NA	
Water Solubility	soluble in cold and hot water	Lide 1991
Density	2.08	Lewis 1993
K <sub>oc</sub>	NA	
Log K <sub>ow</sub>	NA	
Vapor Pressure	NA	
Vapor Density	NA	
Reactivity	aqueous solution corrodes glass	Budavari et al. 1989
Flammability	slightly combustible	Lockheed Martin 1990
Flash Point	NA	
Dissociation Constant (-pK)	NA	
Henry's Law Constant	NA	
Molecular Diffusivity Coefficient	NA	
Air Diffusivity Coefficient	NA	
Fish Bioconcentration Factor	NA	
Odor Threshold	NA	
Conversion Factors	NA	

## II. ENVIRONMENTAL FATE

### A. Environmental Release

Fluoroboric acid may be released into the environment in emissions and effluents from facilities involved in its manufacture or use. It is used primarily in industrial metal plating solutions (60%), in the synthesis of diazo salts (20%), and in metal finishing (20%) (HSDB 1995). It is used in bright dipping solutions for Sn-Pb alloys in printed circuits and other electrical components (HSDB 1995).

### B. Transport

No information was found in the available secondary sources on the environmental transport of fluoroboric acid. Its miscibility with water indicates that transport in aqueous systems is very likely.

### C. Transformation/Persistence

#### FLUOROBORIC ACID:

1. Air — No information was found in the available secondary sources on the transformation and persistence of fluoroboric acid or fluoroborates in the atmosphere.
2. Soil — No information was found in the available secondary sources on the transformation and persistence of fluoroboric acid or fluoroborates in soil. Fluoroboric acid may undergo limited hydrolysis in moist soils (Budavari et al. 1989).
3. Water — Fluoroboric acid undergoes limited hydrolysis in water to form hydroxyfluoroborate ions, the major product is BF<sub>3</sub>OH<sup>-</sup> (Budavari et al. 1989).
4. Biota — No information was found in the available secondary sources on the biotransformation or bioconcentration of fluoroboric acid or fluoroborates. Rapid urinary excretion of tetrafluoroborates suggests that these salts would not bioaccumulate.

**FLUORIDES:**

1. Air — Gaseous inorganic fluorides undergo hydrolysis in the atmosphere; however, particulate forms are relatively stable and do not hydrolyze readily (ATSDR 1993b).
2. Soil — Fluorides tend to persist in soils as fluorosilicate complexes under acidic conditions and as calcium fluoride under alkaline conditions. Sandy acidic soils favor the formation of soluble forms (ATSDR 1993b).
3. Water — In dilute solutions and at neutral pH, fluoride is generally present as dissolved fluoride ion. High calcium carbonate levels may lead to precipitation as calcium fluoride (ATSDR 1993b).
4. Biota — Fluorides have been shown to accumulate in some aquatic organisms (ATSDR 1993b). Soluble forms of fluoride are taken up by terrestrial plants and converted into fluoro-organic compounds (ATSDR 1993b).

## CHEMICAL SUMMARY FOR FORMALDEHYDE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information from these databases or secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of formaldehyde are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF FORMALDEHYDE		
Characteristic/Property	Data	Reference
CAS No.	50-00-0	
Common Synonyms	methanal; oxymethane; methyl aldehyde; formalin (solution)	U.S. EPA 1985b
Molecular Formula	CH <sub>2</sub> O	
Chemical Structure	$\begin{array}{c} \text{O} \\    \\ \text{H}-\text{C}-\text{H} \end{array}$	
Physical State	gas	U.S. EPA 1985b
Molecular Weight	30.03	U.S. EPA 1985b
Melting Point	-118°C	U.S. EPA 1985b
Boiling Point	-19°C @ 1 atm	U.S. EPA 1985b
Water Solubility	≥ 100 mg/mL @ 20°C	Keith and Walters 1985
Specific Gravity	0.815 @ -20/4°C	Verschuereen 1983
Vapor Density (air = 1)	1.03	Verschuereen 1983
K <sub>oc</sub>	≈ 5 (calculated)	U.S. EPA 1985b
Log K <sub>ow</sub>	0.00 (calculated)	Verschuereen 1983
Vapor Pressure	10 mm Hg @ -88°C	Verschuereen 1983
	3883 mm Hg @ 25°C	Howard 1989
Reactivity	flammable gas; in solution reacts with acids, bases, metal salts, and NO <sub>2</sub> ; reducing agent especially in alkali; oxidizes in air to formic acid. Reacts explosively with peroxides and performic acid.	Keith and Walters 1985 Budavari et al. 1989 IARC 1995
Dissociation Constant	No data	
Air Diffusivity Coefficient	No data	
Molecular Diffusivity Coefficient	No data	
Flash Point	50-60°C	Keith and Walters 1985
Henry's Law Constant	1.43 x 10 <sup>-7</sup> atm-m <sup>3</sup> /mole @ 25°C	U.S. EPA 1985b
	3.27 x 10 <sup>-7</sup> atm-m <sup>3</sup> /mole @ 25°C	Howard 1989
Fish Bioconcentration Factor	0.2 (calculated)	U.S. EPA 1985b
Odor Threshold	perception, 0.07 mg/m <sup>3</sup>	Verschuereen 1983
Conversion Factors	1 ppm = 1.248 mg/m <sup>3</sup> ; 1 mg/m <sup>3</sup> = 0.815 ppm	Verschuereen 1983

## II. ENVIRONMENTAL FATE

## A. Environmental Release

Formaldehyde is a colorless gas at room temperature with a characteristic pungent, straw-like odor that becomes suffocating and intolerable at increasing concentrations (U.S. EPA 1985b; Budavari et al. 1989; Verschuereen 1983). It is released into the environment from natural and man-made sources. It is a product of combustion and is found in smoke from wood, wood products, and tobacco; gasoline and diesel engine exhaust; and in the effluent from power plants, incinerators, and refineries (Howard 1989). It can also be made indirectly in the atmosphere by the photochemical oxidation of other organic molecules, many of which are also products of combustion (U.S. EPA 1985b; Howard 1989). The contribution of formaldehyde to the atmosphere from this indirect

source has been estimated to be twice that from automobiles (U.S. EPA 1985b). Formaldehyde is found in some fruits and vegetables including apples (17.3-22.3 µg/g), green onions (13.3-26.3 µg/g), carrots (6.7-10.0 µg/g), and tomatoes (5.7-7.3 µg/g). It has also been measured in commercial shrimp at 0.39-2.15 mg/kg (U.S. EPA 1985b). Solutions of the gas in water (typically, 37% formaldehyde) are known as formalin and are commonly used as biological preserving agents (U.S. EPA 1985b). Atmospheric levels of formaldehyde have been extensively monitored around the world. Air concentrations range from 0-1 parts-per-billion (ppb) measured off the West coast of Ireland to 24-59 ppb in Los Angeles during a photochemical smog episode (U.S. EPA 1985b). Only 25% of 749 air samples taken from suburban/urban sites across the U.S. were found to contain over 2.7 ppb formaldehyde (U.S. EPA 1985b). Concentrations increase with automobile traffic and during photochemical smog episodes (Howard 1989; U.S. EPA 1985b), and decrease markedly with altitude (U.S. EPA 1985b). Formaldehyde concentrations in indoor air vary with activities involving combustion and materials used in construction. Levels of 33-380 ppb were measured in a test kitchen with a gas stove, concentrations of 0.06-1.83 ppb were measured in homes using urea-formaldehyde particle board, and levels of <0.41-8.2 parts-per-million (ppm) were measured in homes with urea-formaldehyde foam insulation (U.S. EPA 1985b). Higher levels are also measured in areas where formaldehyde solutions (formalin) are used, such as funeral homes (0.35-1.39 ppm), anatomy laboratories (1 ppm, mean), and academic laboratories (1.33-2.48 ppm) (U.S. EPA 1985b). Drinking water supplies were found to be free from formaldehyde contamination in a national survey of suspected carcinogens in drinking water. Formaldehyde was also not found in seawater, and was found in only 1/204 samples at 12 ppb from heavily industrialized river basins in the U.S. It was found in the effluent streams from two chemical plants and one sewage treatment plant (Howard 1989).

In 1992, releases of formaldehyde to environmental media, as reported to the TRI by certain types of U.S. industries, totaled about 16,435,148 pounds. Of this amount, 10,903,227 pounds (66.34%) were released to the atmosphere, 4,916,248 pounds (29.91%) were released in underground injection sites, 441,244 pounds (2.68%) were released to surface water, and 174,429 pounds (1.06%) were released to land (TRI92 1994).

## **B. Transport**

Formaldehyde in solution reacts with water to become hydrated. In this form, it becomes less volatile than water; thus, volatilization from the aquatic environment is not expected to be significant (U.S. EPA 1985b). Formaldehyde is known to leach into the soil, and its high water solubility and calculated soil sorption coefficient ( $K_{oc} \approx 5$ ) indicate relatively high mobility, but the actual fate of formaldehyde in the soil is largely unknown (Howard 1989; U.S. EPA 1985b). In the atmosphere, formaldehyde will transfer into rainwater and also adsorb to aerosol particulates (U.S. EPA 1985b). Half-lives of 50 and 19 hours were predicted from a model system for wet and dry deposition, respectively (Howard 1989).

## **C. Transformation/Persistence**

1. Air — Formaldehyde rapidly reacts with free radicals produced by sunlight in the atmosphere. These include primarily hydroxyl radicals and, to a lesser extent, other radicals, especially chlorine and nitrate. A half-life for formaldehyde of about 0.8 days was calculated for the reaction with hydroxyl radicals (U.S. EPA 1985b). Formaldehyde also undergoes direct photolysis (significant absorption of wavelengths between 290 and 370 nm.). The atmospheric half-life of formaldehyde was calculated to be 0.17 days at sea level with the sun at 30° zenith angle. Calculated for the same conditions, but at an altitude of 10 km, the half-life was reduced to 0.08 days (U.S. EPA 1985b).

## APPENDIX C

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2. Soil — No information is available on the fate of formaldehyde in the natural soil environment. However, a number of bacteria and yeasts isolated from soil were able to degrade formaldehyde, suggesting that formaldehyde released to the soil is susceptible to microbial degradation (U.S. EPA 1985b; Howard 1989).
3. Water — Formaldehyde in water is subject to biodegradation. Under aerobic conditions complete degradation was observed in about 30 hours at 20°C utilizing natural water from a lake in Japan and a known amount of formaldehyde. Degradation occurred in about 48 hours under anaerobic conditions. No degradation was seen with sterilized lake water (U.S. EPA 1985b). Activated sludges were shown to be efficient in decomposing formaldehyde in aqueous effluents, and various *Pseudomonas* strains were shown to use formaldehyde as a sole carbon source (U.S. EPA 1985b).
4. Biota — Experiments on fish and shrimp have shown no bioconcentration of formaldehyde. It is a natural metabolic product and not thought to be subject to bioaccumulation (U.S. EPA 1985b).

## CHEMICAL SUMMARY FOR FORMIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of formic acid are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF FORMIC ACID		
Characteristic/Property	Data	Reference
CAS No.	64-18-6	
Common Synonyms	methanoic acid; formylic acid; hydrogen carboxylic acid	HSDB 1995
Molecular Formula	CH <sub>2</sub> O <sub>2</sub>	Budavari et al. 1989
Chemical Structure	HCOOH	Parmeggiani 1983
Physical State	colorless liquid	Budavari et al. 1989
Molecular Weight	46.02	Budavari et al. 1989
Melting Point	8.4°C	Budavari et al. 1989
Boiling Point	100.5°C	Budavari et al. 1989
Water Solubility	miscible with water	Budavari et al. 1989
Density	1.220 @ 20/4°C	Budavari et al. 1989
Vapor Density (air = 1)	1.59	HSDB 1995
K <sub>oc</sub>	not estimated due to ionization	CHEMFATE 1995
Log K <sub>ow</sub>	-0.54	CHEMFATE 1995
Vapor Pressure	42.59 mm Hg at 25°C	CHEMFATE 1995
Reactivity	strong acid in aqueous solution; can react as an acid or aldehyde; reacts explosively with strong oxidizing agents	ACGIH 1991 NTP 1992 HSDB 1995
Flammability	2 (liquid which must be moderately heated before ignition will occur)	HSDB 1995
Flash Point	68.89°C, open cup	ACGIH 1991
Dissociation Constant	3.7515 @ 25°C	CHEMFATE 1995
Henry's Law Constant	1.67 x 10 <sup>-7</sup> atm-m <sup>3</sup> /mole	CHEMFATE 1995
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	0.22 (calculated)	HSDB 1995
Odor Threshold	10 mg/m <sup>3</sup>	Verschueren 1983
Conversion Factors	1 mg/m <sup>3</sup> = 0.52 ppm; 1 ppm = 1.91 mg/m <sup>3</sup>	Verschueren 1983

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Formic acid is a colorless, highly caustic liquid with a pungent odor (Budavari et al. 1989; NTP 1992). It is produced in large quantities (48 million pounds in 1984) and is released to the environment primarily from industrial sources during its production and uses including textile dying and finishing (21% of production); pharmaceuticals (20%); rubber intermediate (16%); leather and tanning treatment (15%); and catalysts (12%). Formic acid is also a component of certain paint strippers and is released in photoprocessing effluents (HSDB 1995). Other sources of formic acid include releases from forest fires, lacquer manufacturing, trash and plastic burning, thermal degradation of polyethylene, and tobacco smoke (NTP 1992). Formic acid also occurs naturally in plants and insects, as a product of microbial degradation of organic matter, and as a product of photooxidation of biogenic and anthropogenic compounds (HSDB 1995). A constituent of ant, wasp, and bee venom, formic acid occurs in mammalian muscle tissue, sweat, and urine (NTP 1992). Formic acid has been measured at concentrations ranging from 4 to 72 ppm in the atmosphere. It has



been detected in river and surface water, in unfinished industrial waste water, and in municipal sewage and discharge water at concentrations ranging from 10 to 80,000  $\mu\text{g/L}$  (SRI 1981, as reported in NTP 1992).

### B. Transport

Formic acid is soluble in water and would not be expected to adsorb significantly to soil or sediments. Formic acid should leach from some soils into groundwater where it probably would biodegrade. The Henry's Law Constant for formic acid ( $1.67 \times 10^{-7} \text{ atm}\cdot\text{m}^3/\text{mole}$ ) indicates that volatilization from water would not be significant. The potential for bioconcentration is low (HSDB 1995).

### C. Transformation/Persistence

1. Air — In the atmosphere, formic acid is rapidly scavenged by rain and dissolved in cloud water and aerosols, reacting with dissolved hydroxyl radicals. In the vapor phase, the acid also reacts with photochemically produced hydroxyl radicals (half-life 34 days) and possibly with alkenes that may be present in urban air (HSDB 1995).
2. Soil — If released on land, formic acid is expected to leach from soils where it would probably biodegrade based on the results of screening studies (HSDB 1995). A field study followed an industrial waste containing 11.4% formic acid that was disposed of by deep well injection as it traveled a distance of 427-823 meters over a 2 to 4-year period. Formic acid was not detected in two observation wells, while a third well contained 0.4%. The disappearance of the acid was attributed to anaerobic degradation or to reaction with mineral material in ground water (HSDB 1995).
3. Water — If released to water, formic acid should biodegrade and not adsorb significantly to sediment (HSDB 1995).
4. Biota — The estimated bioconcentration factor of 0.22 (based on a log/water partition coefficient of -0.54) suggests that formic acid would not bioaccumulate in aquatic organisms (HSDB 1995).

## CHEMICAL SUMMARY FOR GRAPHITE

This chemical was identified by one or more suppliers as a bath ingredient for the conductive ink and graphite process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of graphite are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF GRAPHITE		
Characteristic/Property	Data	Reference
CAS No.	7782-42-5	
Common Synonyms	plumbago; black lead; mineral carbon	Budavari et al. 1989
Molecular Formula	C	ACGIH 1991
Chemical Structure	C	
Physical State	compact crystalline mass of black or gray color with metallic luster	Pendergrass 1983
Molecular Weight	12	NIOSH 1994
Melting Point	3652-3697°C	Pendergrass 1983
Boiling Point	4200°C	Pendergrass 1983
Water Solubility	insoluble	NIOSH 1994
Density	2.0-2.25	NIOSH 1994
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	0 mm Hg at 68°F	NIOSH 1994
Reactivity	reacts with very strong oxidizers such as fluorine, chlorine trifluoride, and potassium peroxide	NIOSH 1994
Flammability	combustible	NIOSH 1994
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data	
Conversion Factors	not applicable	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Graphite exists as a black or gray crystalline mass and occurs naturally in lump, amorphous, and flake forms (Pendergrass 1983). It is found in most parts of the world (Pendergrass 1983) and is usually found with impurities such as quartz, mica, iron oxide, and granite. The crystalline silica content can range from 2% to 25% (ACGIH 1991). Synthetic graphite is produced by heating a mixture of coal or petroleum coke, a binder, and a petroleum-based oil to facilitate extrusion (ACGIH 1991). Although graphite occurs naturally, exposure to graphite is expected to be primarily occupational. No information on the environmental release of graphite was found in the secondary sources searched.

### **B. Transport**

Graphite is insoluble in water (NIOSH 1994) and, therefore, would not be expected to be transported in surface of ground water. No volatilization is expected to occur under natural conditions.

### **C. Transformation/Persistence**

1. Air — Graphite could be present in air as particulate matter which has a settling time of days.
2. Soil — No information on the transformation/persistence of graphite in soil was found in the secondary sources searched.
3. Water — No information on the transformation/persistence of graphite in water was found in the secondary sources searched.
4. Biota — Graphite does not dissociate in water. Although it may be ingested by bottom feeders, it is not expected to accumulate in aquatic organisms..

## CHEMICAL SUMMARY FOR HYDROCHLORIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, non-formaldehyde electroless copper, organic-palladium, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

Hydrochloric acid is formed when the gaseous and highly soluble hydrogen chloride (HCl) is dissolved in water; hydrochloric acid usually contains 20% HCl (constant boiling acid) or 38% HCl (muriatic acid) (Perry et al. 1994). The chemical identity and physical/chemical properties of hydrochloric acid and/or HCl are summarized below, depending on availability.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF HYDROCHLORIC ACID		
Characteristic/Property	Data	Reference
CAS No.	7647-01-0	
Common Synonyms	anhydrous hydrochloric acid; chlorohydric acid; hydrogen chloride; muriatic acid	RTECS 1995
Molecular Formula	HCl	
Chemical Structure	Cl-H	
Physical State	colorless liquid (hydrochloric acid); colorless gas (HCl)	HSDB 1995; WHO 1982
Molecular Weight	36.46	HSDB 1995
Melting Point	—114.8 °C @ 1 atm (freezing point, HCl)	WHO 1982
Boiling Point	—84.9 °C @ 1 atm (HCl)	WHO 1982
Water Solubility	56.1 g/100 mL @ 60 °C (HCl); 82.3 g/100 mL @ 0 °C (HCl)	HSDB 1995 WHO 1982
pH	0.1 (1.0 N), 1.1 (0.1 N), 2.02 (0.01 N), 3.02 (0.001 N)	HSDB 1995
Density	1.05 <sup>15/4 °C</sup> (hydrochloric acid)	HSDB 1995
Vapor Density (air = 1)	1.268 (HCl)	ACGIH 1991
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	not found	
Vapor Pressure	3.54 x 10 <sup>4</sup> mm Hg @ 25 °C (hydrochloric acid)	CHEMFATE 1995
Reactivity	hydrochloric acid with formaldehyde may form bis(chloromethyl)ether, a human carcinogen; hydrochloric acid in contact with various metals or metal salts may form flammable gases or may undergo energetic reactions; hydrochloric acid is corrosive to most metals, HCl is not; pressurized container may explode releasing toxic vapors.	HSDB 1995
Flammability	HCl will not burn	HSDB 1995
Flash Point	not found	
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	0.26-5 ppm; irritating pungent odor	HSDB 1995
Conversion Factors	1 ppm = 1.49 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.67 ppm	Calculated using: ppm = mg/m <sup>3</sup> x 24.45/m.w.

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

HCl occurs naturally in gases evolved from many volcanoes. There are apparently no other natural sources of the chemical, but chlorides are present in the minerals halite, sylvite, and carnallite, and in seawater (HSDB 1995).

HCl is released to the environment from its production and various other industrial processes (WHO 1982). Sources of its release include refuse incineration and the secondary metals industry (such as the smelting of scrap, rather than ore) (HSDB 1995). It is also released from the thermodecomposition of gases, as a by-product in the numerous dehydrohalogenation processes in the production of unsaturated compounds from the parent chlorinated hydrocarbon, and from coal-fired power plants (HSDB 1995).

In 1992, environmental releases of hydrochloric acid, as reported to the TRI by certain types of U.S. industries, totaled about 287.3 million pounds, including 207.8 million pounds to underground injection sites, 77.1 million pounds to the atmosphere, 1.9 million pounds to surface water, and 432,770 pounds to land (TRI92 1994). Hydrochloric acid ranks second highest in the TRI for total releases and transfers.

### **B. Transport**

HCl, highly soluble in water, may be removed from the atmospheric environment by wet deposition. This was illustrated by a study in the Netherlands in which the chemical was washed out from the plume of a coal fired power plant (HSDB 1995).

Anhydrous HCl spilled onto the soil undergoes rapid evaporation and is not expected to infiltrate the soil (HSDB 1995). In contrast, hydrochloric acid spilled onto soil will infiltrate and will dissolve some soil materials, particularly those of a carbonate base. A portion of the acid will be neutralized, but significant amounts will remain, available for transport to the ground water table. The presence of water in the soil influences the rate of movement of the chemical (HSDB 1995).

### **C. Transformation/Persistence**

1. Air — No information was found in the secondary sources searched regarding the transformation/persistence of HCl/hydrochloric acid in the atmosphere.
2. Soil — Hydrochloric acid spilled onto soil will infiltrate and will dissolve some soil materials, particularly those of a carbonate base, which will neutralize a portion of the acid (HSDB 1995). Information regarding other potential reactions of hydrochloric acid in the soil was not available in the secondary sources searched.
3. Water — HCl in water dissociates almost completely; the hydrogen ion is captured by the water molecules to form the hydronium ion (HSDB 1995).
4. Biota — No information was found in the secondary sources searched regarding the transformation/persistence of HCl/hydrochloric acid in biota.

## CHEMICAL SUMMARY FOR HYDROGEN PEROXIDE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, non-formaldehyde electroless copper, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of hydrogen peroxide are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF HYDROGEN PEROXIDE		
Characteristic/Property	Data	Reference
CAS No.	7722-84-1	
Common Synonyms	hydrogen dioxide; hydroperoxide; albone; hioxyl	Budavari et al. 1989
Molecular Formula	H <sub>2</sub> O <sub>2</sub>	Budavari et al. 1989
Chemical Structure	H <sub>2</sub> O <sub>2</sub>	IARC 1985
Physical State	colorless, unstable liquid bitter taste	Budavari et al. 1989
Molecular Weight	34.02	Budavari et al. 1989
Melting Point	-0.43 °C	Budavari et al. 1989
Boiling Point	152 °C	Budavari et al. 1989
Water Solubility	miscible	Budavari et al. 1989
Density	1.463 @ 0 °C	Budavari et al. 1989
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	1.97 mm Hg @ 25 ° C (measured)	CHEMFATE 1995
Reactivity	strong oxidizer; may decompose violently if traces of impurities are present	Budavari et al. 1989
	molecular additions, substitutions, oxidations, reduction; can form free radicals	IARC 1985
Flammability	not flammable, but can cause spontaneous combustion of flammable materials	HSDB 1995
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	Budavari et al. 1989
Conversion Factors	1 ppm = 1.39 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.72 ppm 30% soln 1.1 kg/L anhydrous 1.46 kg/L	IARC 1985 Budavari et al. 1989

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of hydrogen peroxide. Solutions of hydrogen peroxide gradually deteriorate (Budavari et al. 1989). Hydrogen peroxide is a naturally occurring substance. Gaseous hydrogen peroxide is recognized to be a key component and product of the earth's lower atmospheric photochemical reactions, in both clean and polluted atmospheres. Atmospheric hydrogen peroxide is also believed to be generated by gas-phase photochemical reactions in the remote troposphere (IARC 1985)

### B. Transport

No information was found in the secondary sources searched regarding the transport of hydrogen peroxide.

### C. Transformation/Persistence

1. Air — Hydrogen peroxide may be removed from the atmosphere by photolysis giving rise to hydroxyl radicals, by reaction with hydroxyl radicals, or by heterogenous loss processes such as rain-out (IARC 1985).
2. Soil — No information was found in the secondary sources searched regarding the transformation or persistence of hydrogen peroxide in soil, however, solutions of hydrogen peroxide gradually deteriorate (Budavari et al. 1989).
3. Water — Hydrogen peroxide is a naturally occurring substance. Surface water concentrations of hydrogen peroxide have been found to vary between 51-231 mg/L, increasing both with exposure to sunlight and the presence of dissolved organic matter (IARC 1985).
4. Biota — Hydrogen peroxide is a naturally occurring substance. Endogenous hydrogen peroxide has been found in plant tissues at the following levels (mg/kg frozen weight): potato tubers, 7.6; green tomatoes, 3.5; red tomatoes, 3.5; and castor beans in water, 4.7 (IARC 1985).

## CHEMICAL SUMMARY FOR HYDROXYACETIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of hydroxyacetic acid summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF HYDROXYACETIC ACID		
Characteristic/Property	Data	Reference
CAS No.	79-14-1	
Common Synonyms	glycolic acid; hydroxyethanoic acid	Budavari et al. 1989
Molecular Formula	$C_2H_4O_3$	Budavari et al. 1989
Chemical Structure	$HOCH_2COOH$	Budavari et al. 1989
Physical State	somewhat hygroscopic crystals	Budavari et al. 1989
Molecular Weight	76.05	Budavari et al. 1989
Melting Point	80°C	Budavari et al. 1989
Boiling Point	100°C (decomposes)	HSDB 1995
Water Solubility	soluble	Budavari et al. 1989
Density	1.49 @ 25°C	HSDB 1995
Vapor Density (air = 1)	no data	
$K_{oc}$	no data	
Log $K_{ow}$	-1.11	CHEMFATE 1995
Vapor Pressure	8.1 mm Hg @ 80°C	HSDB 1995
Reactivity	incompatible with bases, oxidizing & reducing agents; pH of aqueous solution, 2.5 (0.5%), 2.33 (1%), 2.16 (2%) 1.91 (5%), 1.73 (10%)	Martin Marietta Energy Systems 1994 Budavari et al. 1989
Flammability	capable of creating dust explosion	Eastman Kodak Co. 1989
Flash Point	no data	
Dissociation Constant	3.83 (measured)	CHEMFATE 1995
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	Budavari et al. 1989
Conversion Factors	1 mg/m <sup>3</sup> = 0.32 ppm; 1 ppm = 3.11 mg/m <sup>3</sup>	Calculated: mg/m <sup>3</sup> = 1 ppm (MW/24.45)

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Hydroxyacetic acid is a water soluble solid used in the processing of textiles, leather, and metals, in pH control, and wherever an inexpensive organic acid is needed (Budavari et al. 1989). The chemical can be found in spent sulfite liquor from pulp processing and occurs naturally in sugar cane syrup (HSDB 1995). Hydroxyacetic acid has been detected in the Gulf of Main at concentrations of 0-78  $\mu\text{g/L}$ ; in water samples collected at a 3 meter depth in the Belgian zone of the North Sea; in the eastern parts of the English Channel at concentrations ranging from 0.9 to 3.1  $\mu\text{mol/L}$ ; and in five Madison, Wisconsin, Lakes and in Falkland Islands waters as a product of algal photosynthesis (CHEMFATE 1995).



### B. Transport

No information on the transport of hydroxyacetic acid was found in the secondary sources searched. Hydroxyacetic acid is soluble in water and would be expected to leach through soil. The vapor pressure of 8.1 mm Hg @ 80°C indicates that the chemical is moderately volatile and, therefore, may volatilize to some extent from soils and water. However, a Henry's Law Constant is not available and it is stated that the chemical is water soluble. Hence, even though the vapor pressure is relatively high, volatilization from water may be negligible due to its high water solubility.

### C. Transformation/Persistence

1. Air — No information on the transformation/persistence of hydroxyacetic acid in air was found in the secondary sources searched.
2. Soil — The chemical was not biodegraded by 10 strains of *Arthobacter globiformis* and slowly degraded by *Alcalignes* sp. (CHEMFATE 1995).
3. Water — Stream and groundwater bacteria degraded the chemical with half-lives of 73 days and 4.5 days, respectively (CHEMFATE 1995).
4. Biota — The low log octanol-water coefficient (-1.11) suggests that hydroxyacetic acid would not bioaccumulate.

## CHEMICAL SUMMARY FOR ISOPHORONE

This chemical was identified by one or more suppliers as a bath ingredient for the conductive ink process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of isophorone are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF ISOPHORONE		
Characteristic/Property	Data	Reference
CAS No.	78-59-1	
Common Synonyms	Isoacetophorone	NIOSH 1994
	3,5,5-Trimethyl-2-cyclo-hexenone	
	Isoforon	ATSDR 1989
Molecular Formula	C <sub>9</sub> H <sub>14</sub> O	
Chemical Structure		Howard 1990
Physical State	Clear liquid	Budavari et al. 1996
Molecular Weight	138.21	Budavari et al. 1996
Freezing Point	-8.1 °C	ATSDR 1989
Boiling Point	215.3 °C	ATSDR 1989
Water Solubility	12 g/L (20 °C)	Howard 1990
	14.5 g/L (25 °C)	ATSDR 1989
	0.9229 (20/20 °C)	Keith and Walters 1985
Density	0.923 mg/L (20 °C)	Keith and Walters 1985
Vapor Density (air = 1)	4.77	Verschuereen 1996
Max vapor Conc.	340 ppm (20 °C)	Topping et al. 1994
K <sub>oc</sub>	25; 384	Howard 1990
Log K <sub>ow</sub>	1.67 (20 °C)	ATSDR 1989
	2.22 (est.)	Howard 1990
Vapor Pressure	0.3 mm Hg (20 °C)	Budavari et al. 1996
	0.438 mm Hg (25 °C)	CHEMFATE 1996
Reactivity	Incompatible with strong oxidizers	HSDB 1996
	0.8-3.5 vol %	Keith and Walters 1985
Flammability Limits	84 °C	ATSDR 1989
Flash Point (open cup)		Budavari et al. 1996
Henry's Law Constant	5.8 x 10 <sup>-6</sup> atm-m <sup>3</sup> /mol (20 °C)	Howard 1990
Molecular Diffusivity Coefficient	No data	
Air Diffusivity Coefficient	No data	
Fish Bioconcentration Factor	7 (bluegill)	Verschuereen 1996
Odor Threshold - air	0.20 (v/v)	ATSDR 1989
Conversion Factors	1 ppm = 5.74 mg/m <sup>3</sup>	NIOSH 1994
	1 mg/m <sup>3</sup> = 0.17 ppm	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Isophorone is not listed on the TRI (TRI93 1995). Information on the amounts released into various environmental media was not found in the available secondary sources.

#### B. Transport

If released to soil or water, isophorone may be transported to air by volatilization (Howard 1990). Based on a Henry's Law Constant of 5.8 x 10<sup>-6</sup> atm-m<sup>3</sup>/mol, the half-life from a model river 1 m deep and flowing 1 m/sec was estimated to be about 7.5 days (Howard 1990). Isophorone is not expected to be adsorbed to suspended solids or sediments. K<sub>oc</sub> values of 25 and 384 have been estimated for

isophorone from data on water solubility (12 g/L at 20°C) and  $K_{ow}$  ( $\log K_{ow} = 1.67$  at 20°C), indicating that leaching through soils to ground water is possible (Howard 1990). Based on its vapor pressure of 0.3 mm Hg, isophorone is expected to exist in the air primarily in the vapor phase (Howard 1990). Isophorone emitted to the atmosphere in particulate form may be removed by wet or dry deposition (Howard 1990).

### C. Transformation/Persistence

1. Air — The major degradation pathway for isophorone in air is expected to be by reaction with ozone, with a estimated half-life of 39 min (Howard 1990). Reaction with photochemically generated hydroxyl radicals is not expected to be as significant (half-life 3 hr) (Howard 1990). Overall half-life in air has been estimated to be 32 min (Howard 1990).
2. Soil — The potential exists for transport of isophorone to ground water by leaching through soil (Howard 1990). Biodegradation is a likely degradation pathway in soils.
3. Water — Isophorone is not expected to be adsorbed to suspended solids or sediments, or to be photolyzed, oxidized by reaction with singlet oxygen, oxidized by alkylperoxy radicals or undergo chemical hydrolysis (Howard 1990). Isophorone may undergo biodegradation in water (Howard 1990).
4. Biota — Isophorone is not expected to bioaccumulate (Howard 1990). A bioconcentration factor of 7 was reported for bluegill sunfish (Howard 1990). The half-life of isophorone in fish tissue was estimated to be 1 day, indicating a low potential for bioaccumulation (Howard 1990)

## CHEMICAL SUMMARY FOR ISOPROPANOL

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, non-formaldehyde electroless copper, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of isopropanol are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF ISOPROPANOL		
Characteristic/Property	Data	Reference
CAS No.	67-63-0	
Common Synonyms	isopropyl alcohol; 2-propanol; dimethyl carbinol	U.S. EPA 1989
Molecular Formula	C <sub>3</sub> H <sub>8</sub> O	IARC 1977
Chemical Structure	CH <sub>3</sub> -CHOH-CH <sub>3</sub>	IARC 1977
Physical State	colorless liquid	IARC 1977
Molecular Weight	60.09	Budavari et al. 1989
Melting Point	-88.5°C	Budavari et al. 1989
Boiling Point	82.5°C at 760 mm Hg	Budavari et al. 1989
Water Solubility	> 10%	Weast 1985
Density	0.78505 g/mL	Budavari et al. 1989
Vapor Density (air = 1)	2.08	HSDB 1995
K <sub>oc</sub>	25	CHEMFATE 1995
Log K <sub>ow</sub>	0.05	CHEMFATE 1995
Vapor Pressure	32.4 mm Hg at 20°C 44 mm Hg at 25°C	IARC 1977 Rowe and McCollister 1982
Reactivity	attacks some forms of plastic, rubber, and coatings.	HSDB 1995
Flammability	flammable/combustible	HSDB 1995
UV Absorption Coefficient	2.79 (mole-cm) <sup>-1</sup> at 181 nm	CHEMFATE 1995
Flash Point	11.7°C (closed cup) 18.3°C (open cup)	ACGIH 1991
Dissociation Constant	17.1 (pK <sub>a</sub> )	CHEMFATE 1995
Henry's Law Constant	7.89 × 10 <sup>-6</sup> atm m <sup>3</sup> /mole	CHEMFATE 1995
Molecular Diffusivity Coefficient	NA	
Air Diffusivity Coefficient	NA	
Fish Bioconcentration Factor	-0.19	CHEMFATE 1995
Odor Threshold	22 and 40 ppm	Lington and Bevan 1994
Conversion Factors	1 ppm = 2.50 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.4 ppm	NIOSH 1994

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Isopropanol is released into the environment in emissions from chemical manufacturing plants and as a result of its use in consumer products such as a rubbing alcohol, cosmetics, and antifreezes (HSDB 1995). The chemical is also released as a natural volatile from vegetation, nuts, and milk products, and as a result of microbial degradation of animal wastes (HSDB 1995).

Of the total 1,357,992 pounds of isopropanol released to the environment in 1993, as reported to the TRI by certain types of U.S. industries, 1,357,242 pounds were released to the atmosphere and 750 pounds were released onto land; no releases were reported for surface waters or underground injection sites (TRI93 1995).

### B. Transport

Following releases onto land, isopropanol is likely to volatilize into the atmosphere due to its high vapor pressure (32.4 mm Hg at 20°C). Transport through soil to groundwater is also possible considering the chemical's water solubility (>10%) and low  $K_{oc}$  value (25). When released into water, isopropanol will slowly volatilize into the atmosphere (Henry's law constant  $7.89 \times 10^{-6}$  atm  $m^3/mole$ ); the estimated half-life for volatilization from water 1 m deep with a 1 m/sec current and a 3 m/sec wind speed is 3.6 days (Mackay et al. 1992). Because of its miscibility with water and its low potential for adsorption to sediments, downstream transport is also possible (HSDB 1995). Transport through the atmosphere may be limited by photodegradation and removal in precipitation (HSDB 1995).

### C. Transformation/Persistence

1. Air — Isopropanol exhibited a low level of reactivity when tested in a smog chamber; a 20% decrease in concentration occurred in 5 hr and 250-255 min was required for maximum  $NO_x$  production (CHEMFATE 1995). The rate constant for its reaction with OH radicals is 0.547E-11, and that for reaction with O(3P) radicals is 0.22E-12 (CHEMFATE 1995). Photo-oxidation half-lives of 6.2-72 hr (based on rate of disappearance of the hydrocarbon) and 6.2-72 hr (based on the OH reaction rate constant) have been reported (Mackay et al. 1992).
2. Soil — A half-life of 24-168 hr was calculated from an estimate of the biodegradation half-life under unacclimated aerobic aqueous conditions (Mackay et al. 1992).
3. Water — Reaction of isopropanol with hydroxyl radicals in water is slow; half-lives of 1.09 yr (CHEMFATE 1995) and 197 days to 22 yr (Mackay et al. 1992) have been estimated. Based on an estimate of the unacclimated aerobic aqueous biodegradation rate, the half-lives of isopropanol in surface and groundwater were estimated to be 26-168 hr and 48-336 hr, respectively (Mackay et al. 1992).
4. Biota — Isopropanol is subject to biodegradation in activated sludge systems (CHEMFATE 1995). Microbial species including Arthrobacter sp., Achromobacter sp., and Alcaligenes faecalis have been shown to be capable of degrading isopropanol (CHEMFATE 1995). The low  $\log K_{ow}$  value of 0.05 for isopropanol indicates that bioconcentration and bioaccumulation are not likely to be important environmental fate processes (HSDB 1995).

## CHEMICAL SUMMARY FOR LITHIUM HYDROXIDE

This chemical was identified by one or more suppliers as a bath ingredient for the tin-palladium process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of lithium hydroxide are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF LITHIUM HYDROXIDE		
Characteristic/Property	Data	Reference
CAS No.	1310-66-3	
Common Synonyms	lithium hydroxide hydrate lithium hydroxide, monohydrate	Sigma 1992
Molecular Formula	LiOH·H <sub>2</sub> O	
Chemical Structure	LiOH·H <sub>2</sub> O	
Physical State	white crystals	Sigma 1992
Molecular Weight	41.96	Beliles 1994a
Melting Point	470°C	Lewis 1993
Boiling Point	924°C (decomposes)	Lewis 1993
Water Solubility	223 g/L at 10°C	Beliles 1994a
Density	1.51	Beliles 1994a
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	incompatible with strong oxidizing agents and strong acids; binds CO <sub>2</sub>	Sigma 1992
Flammability	no data; emits toxic fumes under fire conditions	Sigma 1992
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data	
Conversion Factors	not applicable	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

For the production of lithium hydroxide, lithium ore is heated with limestone to about 1000°C; water leaching of the kiln product yields lithium hydroxide. Lithium hydroxide is used as a CO<sub>2</sub> absorbent in space vehicles and submarines, as a storage battery electrolyte, in lubricating greases, and in ceramics (Beliles 1994a).

Releases of lithium to the environment are most likely in the form of inorganic salts or oxides (Beliles 1994a). Lithium hydroxide is not listed on the EPA's TRI, requiring certain U.S. industries to report on chemical releases to the environment (TRI93 1995).

### **B. Transport**

No information was found in the secondary sources searched regarding the transport of lithium hydroxide through the environment. Lithium occurs naturally in certain minerals and lithium compounds are found in natural waters and some foods (Beliles 1994a).

### **C. Transformation/Persistence**

No information was found in the secondary sources searched regarding the transformation/persistence of lithium hydroxide in air, water, soil, or biota.

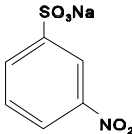
## CHEMICAL SUMMARY FOR m-NITROBENZENE SULFONIC ACID, SODIUM SALT

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of m-nitrobenzene sulfonic acid, sodium salt, are summarized below.

#### CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF m-NITROBENZENE SULFONIC ACID, SODIUM SALT

Characteristic/Property	Data	Reference
CAS No.	127-68-4	
Common Synonyms	sodium 3-nitrobenzenesulfonate; ludigol; nacan	HSDB 1995
Molecular Formula	C <sub>6</sub> H <sub>5</sub> NO <sub>3</sub> S.Na	HSDB 1995
	Chemical Structure	
		
Physical State	white to light	
yellow solid	Sigma-Aldrich 1993	
Molecular Weight	225.16	HSDB 1995
Melting Point	no data	
Boiling Point	no data	
Water Solubility	no data	
Density	no data	
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	-2.61	Greim et al. 1994
Vapor Pressure	no data	
Reactivity	incompatible with strong oxidizers, brass, cadmium, copper, nickel	Sigma-Aldrich 1993
Flammability	no data	
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data	
Conversion Factors	no data	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of nitrobenzene sulfonic acid, sodium salt.



### B. Transport

No information was found in the secondary sources searched regarding the transport of nitrobenzene sulfonic acid, sodium salt.

### C. Transformation/Persistence

1. Air — No information was found in the secondary sources searched regarding the transformation/persistence of nitrobenzene sulfonic acid, sodium salt, in air.
2. Soil — No information was found in the secondary sources searched regarding the transformation/persistence of nitrobenzene sulfonic acid, sodium salt, in soil.
3. Water — The biodegradability of nitrobenzene sulfonic acid, sodium salt, is greater than 70 % in the Zahn-Wellens or coupled-unit test (Greim et al. 1994).
4. Biota — The Log  $P_{ow}$  (equivalent to a log  $K_{ow}$ ) for nitrobenzene sulfonic acid, sodium salt, is  $-2.61$ ; therefore, no significant bioaccumulation is expected (Greim et al. 1994).

## CHEMICAL SUMMARY FOR MAGNESIUM CARBONATE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of magnesium carbonate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF MAGNESIUM CARBONATE		
Characteristic/Property	Data	Reference
CAS No.	546-93-0	
Common Synonyms	magnesite carbonic acid, magnesium salt (1:1)	ACGIH 1991 HSDB 1995
Molecular Formula	MgCO <sub>3</sub>	ACGIH 1991
Chemical Structure	MgCO <sub>3</sub>	ACGIH 1991
Physical State	white, yellowish, grayish-white, or brown crystalline solid	ACGIH 1991
Molecular Weight	84.33	ACGIH 1991
Melting Point	decomposes @ 350° C	Beliles 1994b
Boiling Point	900° C	ACGIH 1991
Water Solubility	106 mg/L @ 20° C	ACGIH 1991
Density	2.958	ACGIH 1991
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	readily reacts with acids liberates CO <sub>2</sub>	HSDB 1995 Beliles 1994b
Flammability	no data	
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless, but readily absorbs odors	HSDB 1995
Conversion Factors	not applicable	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Magnesium carbonate occurs naturally as magnesite (HSDB 1995). The “cold” operations in the magnesite industry, mining and processing of raw material and clinker, and brick preparation, are characterized by a high dust content in the working environment with only insignificant amounts of solid particles escaping into the atmosphere (Reichrtova and Takac 1992). Magnesium carbonate is not one of the chemicals reported to the TRI by certain types of U.S. industries.

#### B. Transport

No specific information was found in the secondary sources searched regarding the transport of magnesium carbonate. It is, however, moderately soluble in water and would be expected to move through the environment.

### C. Transformation/Persistence

1. Air — No information was found in the secondary sources searched regarding the transformation/persistence of magnesium carbonate in air. It is, however, moderately soluble in water and would be expected to be deposited in rainwater.
2. Soil — No information was found in the secondary sources searched regarding the transformation/persistence of magnesium carbonate in soil.
3. Water — Magnesite occurs in seawater, seawater bitterns, and well brines. In fresh water, dissolved magnesium salts (along with calcium salts) are responsible for the hardness of water (Beliles 1994b). Magnesium carbonates comprise a significant fraction of the sediments of selected lakes and streams studied in the upper Qu'Appelle River basin in southern Saskatchewan, Canada (Oscarson et al. 1981).
4. Biota — No specific information was found in the secondary sources searched regarding the transformation/persistence of magnesium carbonate in biota.

## CHEMICAL SUMMARY FOR METHANOL

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper and conductive ink processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical and chemical properties of methanol are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF METHANOL		
Characteristic/Property	Data	Reference
CAS No.	67-56-1	
Common Synonyms	methyl alcohol, carbinol, wood spirit, wood alcohol	Budavari et al. 1989
Molecular Formula	CH <sub>3</sub> O	Budavari et al. 1989
Chemical Structure	$  \begin{array}{c}  \text{H} \\    \\  \text{H} - \text{C} - \text{OH} \\    \\  \text{H}  \end{array}  $	
Physical State	colorless liquid	Verschuereen 1983
Molecular Weight	32.04	Budavari et al. 1989
Melting Point	-97.8°C	Budavari et al. 1989
Boiling Point	64.7°C at 760 mm Hg	Budavari et al. 1989
Water Solubility	miscible	Budavari et al. 1989
Density	d <sub>20</sub> <sup>4</sup> , 0.7915 g/mL	Budavari et al. 1989
Vapor Density (air = 1)	1.11	Budavari et al. 1989
K <sub>OC</sub>	9	CHEMFATE 1995
Log K <sub>OW</sub>	-0.77	CHEMFATE 1995
Vapor Pressure	126 mm Hg at 25°C	CHEMFATE 1995
Flammability	flammable	Budavari et al. 1989
Reactivity	may explode when exposed to flame	HSDB 1995
Dissociation Constant	15.3	CHEMFATE 1995
Flash Point	12°C	Budavari et al. 1989
Henry's Law Constant	4.55 x 10 <sup>-6</sup> atm·m <sup>3</sup> /mol	CHEMFATE 1995
Bioconcentration Factor	0.2 (estimated)	HSDB 1995
Molecular diffusivity coefficient	no data	
Air diffusivity coefficient	no data	
Odor Threshold	100 ppm	Lington and Bevan 1994
Conversion Factors	1 ppm = 1.33 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.764 ppm	Verschuereen 1983

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Methanol ranked third in the U.S. among all chemicals for total releases into the environment in 1992. Of the total released, 195 million pounds were into the atmosphere, 43.5 million pounds were into surface and ground waters, and 3.3 million pounds were onto land (TRI92 1994). Methanol detected in the air from Point Barrow, Alaska averaged 0.77 ppb (CHEMFATE 1995). Ambient concentrations from Stockholm, Sweden, ranged from 3.83 to 26.7 ppb while concentrations from two remote locations in Arizona were 7.9 and 2.6 ppb (HSDB 1995). In one survey, methanol was detected in drinking waters from 6 of 10 U.S. cities (HSDB 1995) but levels were not included. The chemical has also been detected at a level of 22 ppb in rainwater collected from Santa Rita, Arizona (HSDB 1995).

### B. Transport

The miscibility of methanol in water and a low  $K_{oc}$  of 9 indicate that the chemical will be highly mobile in soil (HSDB 1995). Volatilization half-lives from a model river and an environmental pond were estimated at 4.8 days and 51.7 days, respectively (HSDB 1995). Methanol can be removed from the atmosphere in rain water (HSDB 1995).

### C. Transformation/Persistence

1. Air — Once in the atmosphere, methanol exists in the vapor phase with a half life of 17.8 days (HSDB 1995). The chemical reacts with photochemically produced hydroxyl radicals to produce formaldehyde (HSDB 1995). Methanol can also react with nitrogen dioxide in polluted air to form methyl nitrite (HSDB 1995).
2. Soil — Biodegradation is the major route of removal of methanol from soils. Several species of *Methylobacterium* and *Methylomonas* isolated from soils are capable of utilizing methanol as a sole carbon source (CHEMFATE 1995).
3. Water — Most methanol is removed from water by biodegradation. The anaerobic degradation products methane and carbon dioxide were detected from aqueous cultures of mixed bacteria isolated from sewage sludge (CHEMFATE 1995). Aerobic, gram-negative bacteria (65 strains) isolated from seawater, sand, mud, and weeds of marine origin utilized methanol as a sole carbon source (CHEMFATE 1995). Aquatic hydrolysis, oxidation, and photolysis are not significant fate processes for methanol (HSDB 1995).
4. Biota — Bioaccumulation of methanol in aquatic organisms is not expected to be significant based on an estimated bioconcentration factor of 0.2 (HSDB 1995).

## CHEMICAL SUMMARY FOR *p*-TOLUENE SULFONIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of *p*-toluene sulfonic acid are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF <i>p</i> -TOLUENE SULFONIC ACID		
Characteristic/Property	Data	Reference
CAS No.	104-15-4	
Common Synonyms	4-Methylbenzenesulfonic acid; tosic acid	Budavari et al. 1989
Molecular Formula	$C_7H_7O_2S$	
Chemical Structure	$CH_3C_6H_4SO_3H$	Budavari et al. 1989
Physical State	Crystalline; monoclinic leaflets or prisms	Budavari et al. 1989
Molecular Weight	172.2	Budavari et al. 1989
Melting Point	106-107°C (anhydrous) 38°C (metastable form)	Budavari et al. 1989
Boiling Point	140°C @ 20 mm Hg	Weast 1987
Water Solubility	67 g/100 mL (approximate)	Budavari et al. 1989
Specific Gravity	No data	
Vapor Density (air = 1)	No data	
$K_{oc}$	No data	
Log $K_{ow}$	No data	
Vapor Pressure	Low	HSDB 1995
Reactivity	NFPA reactivity, 1; normally stable, but may become unstable at elevated temperatures. Releases toxic fumes of $SO_x$ when heated to decomposition.	HSDB 1995
Flammability	NFPA flammability, 1; must be preheated before ignition can occur.	HSDB 1995
Flash Point	184°C	HSDB 1995
Dissociation Constant	-1.34 (measured, uncertain)	CHEMFATE 1995
Henry's Law Constant	Very low due to low vapor pressure and high solubility.	HSDB 1995
Molecular Diffusivity Coefficient	No data	
Air Diffusivity Coefficient	No data	
Fish Bioconcentration Factor	No data, predicted low.	HSDB 1995
Taste Threshold	No data	
Conversion Factors	1 ppm = 7.03 mg/m <sup>3</sup> ; 1 mg/m <sup>3</sup> = 0.142 ppm	Calculated

a) Calculated utilizing:  $mg/m^3 = ppm \times MW/24.5$  @ 25°C & 760 mm Hg.

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

*p*-Toluene sulfonic acid is manufactured for use as a chemical intermediate in the synthesis of dyes, antidiabetic drugs, chemicals used in detergents, and in the synthesis of other organic chemicals (Budavari et al. 1989; HSDB 1995). The exposure of humans to *p*-toluene sulfonic acid is primarily by dermal contact or inhalation during the manufacture or use of the chemical in occupational settings (HSDB 1995). Due to its high water solubility (about 67 g/100 mL), exposure may also occur in drinking water. *p*-Toluene sulfonic acid has been detected qualitatively in lowland river water and in groundwater in Britain (HSDB 1995). Based on a 1983 National Institute for Occupational Safety and Health (NIOSH) National

Occupational Hazard Survey, 16,526 workers are potentially exposed to *p*-toluene sulfonic acid in the U.S. (HSDB 1995).

### B. Transport

Because of its water solubility, *p*-toluene sulfonic acid is expected to be highly mobile in soils and leach rapidly into ground waters. Once in the water, the chemical should not move into the atmosphere or onto sediments, but will degrade slowly (HSDB 1995).

### C. Transformation/Persistence

1. Air — Very small amounts of *p*-toluene sulfonic acid enter the atmosphere from water solutions or from the involatile solid. Once in the air, it rapidly reacts with hydroxyl radicals resulting in a half-life of about 2 days (HSDB 1995).
2. Soil — Specific studies on the transformation/persistence of *p*-toluene sulfonic acid in the soil were not available; however, *p*-toluene sulfonic acid is expected to rapidly leach from the soil into ground water because of its high solubility. It is not expected to volatilize into the atmosphere from the soil (HSDB 1995). Although biodegradation is known to occur in water (see II.C.3.), specific information on the biodegradation of *p*-toluene sulfonic acid in the soil is not available (HSDB 1995).
3. Water — *p*-Toluene sulfonic acid primarily enters the environment in wastewater from its production and use. It is ionized in solution and does not significantly transfer into the sediment or into the atmosphere from the aquatic environment (HSDB 1995). It does not absorb light above 290 nm in solution and will not photodegrade or react with water under environmental conditions (HSDB 1995). Biodegradation is highly dependent on the presence of the proper acclimated microbial populations. Complete (100%) degradation in a few days was reported with activated sludge, whereas no degradation was seen for up to 64 days in the absence of activated microorganisms (HSDB 1995). *Pseudomonas* bacteria have been isolated from sludge and river water that can utilize *p*-toluene sulfonic acid as a sole carbon and sulfur source (CHEMFATE 1995; Kertesz et al. 1994).
4. Biota — Although no specific data are available, *p*-toluene sulfonic acid is not expected to bioconcentrate since it is highly water soluble and ionized in solution (HSDB 1995). Experiments with *Ricinus communis* L. (castor bean) have shown that plants absorb and transport *p*-toluene sulfonic acid to the leaves (Bromilow et al. 1993); however, it is not expected to bioconcentrate in food products (HSDB 1995).

## CHEMICAL SUMMARY FOR PALLADIUM AND PALLADIUM CHLORIDE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of palladium and palladium chloride are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF PALLADIUM		
Characteristic/Property	Data	Reference
CAS No.	7440-05-3	
Common Synonyms	none found in the secondary sources searched	
Molecular Formula	Pd	
Chemical Structure	Pd	
Physical State	silver-white, ductile metal	HSDB 1995
Molecular Weight	106.4	HSDB 1995
Melting Point	not found	
Boiling Point	not found	
Water Solubility	insoluble	HSDB 1995
Density	12.02 g/cm <sup>3</sup>	HSDB 1995
Vapor Density (air = 1)	not found	
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	not found	
Vapor Pressure	not found	
Reactivity	appreciably volatile at high temperatures; is converted to the oxide at red heat; can absorb and retain over 800 times its volume of hydrogen, resulting in an expansion of several percent; incompatible with arsenic, carbon, ozonides, sodium tetrahydroborate, and sulfur	HSDB 1995
Flammability	palladium black or finely divided palladium is usually pyrophoric and requires handling precautions; the dust of palladium can be a fire and explosion hazard	HSDB 1995
Flash Point	not found	
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	not found	
Conversion Factors	not applicable	



## APPENDIX C

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF PALLADIUM CHLORIDE		
Characteristic/Property	Data	Reference
CAS No.	7647-10-1	
Common Synonyms	palladium(2+) chloride; palladous chloride	RTECS 1995
Molecular Formula	PdCl <sub>2</sub>	
Chemical Structure	Cl <sub>2</sub> -Pd	
Physical State	dark red cubic needles	HSDB 1995
Molecular Weight	177.30	HSDB 1995
Melting Point	678-680°C; deliquescent, decomposes at 500°C	HSDB 1995
Boiling Point	not found	
Water Solubility	soluble	HSDB 1995
Density	6.0 g/m <sup>3</sup>	HSDB 1995
Vapor Density (air = 1)	not found	
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	not found	
Vapor Pressure	not found	
Reactivity	not found	
Flammability	not found	
Flash Point	not found	
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	not found	
Conversion Factors	1 ppm = 7.25 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.138 ppm	Calculated using: ppm = mg/m <sup>3</sup> x 24.45/m.w.

## II. ENVIRONMENTAL FATE

### A. Environmental Release

Palladium occurs in the earth's crust, at the concentration of 0.2 ppm, in association with the rare metals of Group VIII (platinum, ruthenium, rhodium, osmium, and iridium) (Venugopal and Luckey 1978; Amdur et al. 1991). The release of palladium to the environment may occur as a result of the mining, refining, fabrication, and use of the metal (Seiler and Sigel 1988). Palladium has been incorporated into catalysts used to control emissions in automobile exhausts; however, the minute quantities emitted are in a biologically inert form (Seiler and Sigel 1988). No significant concentrations were detected near busy highways following 10 years of this use (Seiler and Sigel 1988).

### B. Transport

No information was found in the secondary sources searched regarding the environmental transport of palladium or palladium chloride.

### C. Transformation/Persistence

1. Air — No information was found in the secondary sources searched regarding the transformation/persistence of palladium or palladium chloride in air.
2. Soil — No information was found in the secondary sources searched regarding the transformation/persistence of palladium or palladium chloride in soil.
3. Water — No information was found in the secondary sources searched regarding the transformation/persistence of palladium or palladium chloride in water.
4. Biota — There is no evidence that palladium accumulates in mammals following ingestion (HSDB 1995); however, the metal was present in all tissues analyzed from rats 104 days after intravenous injection (Beliles 1994a).

## CHEMICAL SUMMARY FOR PEROXYMONOSULFURIC ACID, MONOPOTASSIUM SALT

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, conductive polymer, and graphite processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of peroxymonosulfuric acid, monopotassium salt are summarized below.

#### CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF PEROXYMONOSULFURIC ACID, MONOPOTASSIUM SALT

Characteristic/Property	Data	Reference
CAS No.	10058-23-8	
Common Synonyms	monopotassium peroxymonosulfurate; potassium peroxymonosulfate	RTECS 1995
Molecular Formula	HO <sub>5</sub> SK	RTECS 1995
Chemical Structure	$  \begin{array}{c}  \text{O} \\     \\  \text{KOSO} \\     \\  \text{O}  \end{array}  $	
Physical State	no data	
Molecular Weight	152.17	RTECS 1995
Melting Point	no data	
Boiling Point	no data	
Water Solubility	no data	
Density	no data	
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	no data	
Flammability	no data	
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data	
Conversion Factors	no data	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

No information on the environmental release of peroxymonosulfuric acid, monopotassium salt were found in the secondary sources searched.

#### B. Transport

No information on the transport of peroxymonosulfuric acid, monopotassium salt was found in the secondary sources searched.

### **C. Transformation/Persistence**

No information on the transformation/persistence of peroxymonosulfuric acid, monopotassium salt in air, soil, water, or biota was found in the secondary sources searched.

## CHEMICAL SUMMARY FOR PHENOL-FORMALDEHYDE COPOLYMER

This chemical was identified by one or more suppliers as a bath ingredient for the conductive ink process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of phenol-formaldehyde copolymer are summarized below.

#### CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF PHENOL-FORMALDEHYDE COPOLYMER

Characteristic/Property	Data	Reference
CAS No.	9003-35-4	Harris and Sarvadi 1994
Common Synonyms	Phenol-formaldehyde resin	Harris and Sarvadi 1994
Molecular Formula	(C <sub>6</sub> H <sub>6</sub> O.CH <sub>2</sub> O) <sub>n</sub>	Harris and Sarvadi 1994
Chemical Structure	not found	
Physical State	solid (when cured) viscous liquid (uncured)	
Molecular Weight	300-700 (one-step process) <sup>a</sup> 1200-1500 (two-step process) <sup>a</sup> Several hundred thousand (cured resin)	Harris and Sarvadi 1994 Harris and Sarvadi 1994 Harris and Sarvadi 1994
Melting Point	not found	
Boiling Point	not found	
Water Solubility	Soluble (non-cured resin) Insoluble (cured resin)	Harris and Sarvadi 1994 Harris and Sarvadi 1994
Density	not found	
Vapor Density (air = 1)	not found	
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	not found	
Vapor Pressure	not found	
Reactivity	High chemical resistance	Harris and Sarvadi 1994
Flammability	Fire retardant	Harris and Sarvadi 1994
Flash Point	not found	
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	not found	
Conversion Factors	not found	

a) "One-step" and "two-step" refer to the manufacturing process used to make the resin.

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Phenol-formaldehyde (PF) copolymer is used in a wide variety of products including wood composites (plywood, particleboard, fiberboard), molding materials (in appliances, electric controls, telephones, and wiring services), and as a binder for thermal and sound insulation materials (e.g., glass fibers and mineral wool) (Opresko 1991). There are no reports of any detrimental toxic effects from cured phenolic resins; therefore, the greatest hazards associated with these substances is expected to occur during the manufacture, processing, and handling of the uncured resin (Opresko 1991). However, loss of both phenol and formaldehyde has been observed for many months after fabrication of foam insulation for refrigerators (Opresko 1991). Phenol was identified as one of a

number of volatile organic compounds found in indoor air as a result of emissions from construction and interior finish materials and adhesives used in such products (Opresko 1991). A study on workers exposed to phenolic resin fumes for periods of less than 1 year to more than 5 years reported PF component levels of 7-10 mg phenol/m<sup>3</sup> and 0.5-1.0 mg formaldehyde/m<sup>3</sup> (Opresko 1991). Most environmental release of PF components would likely come from such manufacturing operations. Both monomeric components of PF copolymer, phenol and formaldehyde, have been profiled separately (U.S. EPA 1995a, 1996a).

### **B. Transport**

No information was found in the secondary sources searched regarding the environmental transport of PF copolymer. Cured PF resin is a water insoluble solid and would not be a likely groundwater contaminant. Offgassing of PF component monomers during processing and, to a lesser extent, after curing would be the most probable mode of environmental transport.

### **C. Transformation/Persistence**

1. Air — No information was found in the secondary sources searched regarding the transformation/persistence of PF copolymer in air.
2. Soil — PF copolymer is highly resistant to biological decay (Harris and Sarvadi 1994). This fact, coupled with its low water solubility, suggest that PF copolymer would be persistent in soil.
3. Water — No information was found in the secondary sources searched regarding the transformation/persistence of PF copolymer in water. Because of its very low water solubility, cured PF copolymer is not likely to be a contaminant of groundwater.
4. Biota — No information was found in the secondary sources searched regarding the bioaccumulation of PF copolymer.

## CHEMICAL SUMMARY FOR PHOSPHORIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the conductive polymer and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of phosphoric acid are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF PHOSPHORIC ACID		
Characteristic/Property	Data	Reference
CAS No.	7664-38-2	
Common Synonyms	orthophosphoric acid	Budavari et al.1989
Molecular Formula	H <sub>3</sub> O <sub>4</sub> P	Budavari et al.1989
Chemical Structure	$  \begin{array}{c}  \text{HO} \quad \text{O} \\  \quad \quad \parallel \\  \quad \quad \text{P} - \text{OH} \\  \quad \quad / \\  \text{HO}  \end{array}  $	Budavari et al.1989
Physical State	unstable, orthorhombic crystals or syrupy liquid	Budavari et al.1989
Molecular Weight	98.00	Budavari et al.1989
Melting Point	42.35	Budavari et al.1989
Boiling Point	@ 213° C losing ½ water	HSDB 1995
Water Solubility	548g/100 mL	HSDB 1995
Density	1.8741 @ 25 (100% soln.)	Budavari et al.1989
Vapor Density (air = 1)	3.4	HSDB 1995
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	0.03 mm Hg @ 20°C	
Reactivity	Hot concd acid attacks porcelain and granite ware Reacts w/metals to liberate flammable H <sub>2</sub> gas sodium tetraborate; aldehydes; cyanides bleach; ammonia	Budavari et al.1989 HSDB 1995 HSDB 1995 NIOSH 1994
Flammability	not combustible, but contact w/common metals liberates hydrogen	HSDB 1995
Flash Point	no data	
Dissociation Constant	K <sub>1</sub> =7.107 x 10 <sup>-3</sup>	Budavari 1989
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	Odorless	HSDB 1995
Conversion Factors	no data	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Of the total 206.6 million pounds of phosphoric acid released into the environment in 1992, as reported to the TRI by certain types of U.S. industries, 1.2 million pounds were released into the atmosphere, 158.7 million pounds were released into ground or surface waters, and 46.7 million pounds were released onto the land (TRI92 1994).

### B. Transport

When spilled onto soil, phosphoric acid will infiltrate downward, the rate being greater with lower concentrations because of reduced viscosity. Upon reaching the groundwater table, phosphoric acid will move in the direction of the groundwater flow (HSDB 1995).

### C. Transformation/Persistence

1. Air — Phosphoric acid may be present in air as a mist or a vapor, but it exists primarily as a mist because of its low volatility and its affinity for water (IARC 1992).
2. Soil — During transport through soil, phosphoric acid will dissolve some of the soil material, in particular carbonate based materials. The acid will be neutralized to some degree with adsorption of the proton and phosphate ions also possible. However significant amounts of acid will remain for transport to groundwater (HSDB 1995).
3. Water — Upon reaching groundwater, a contaminated plume will be produced with dilution and dispersion serving to reduce the acid concentration (HSDB 1995). However, while acidity may be reduced readily by natural water hardness minerals, the phosphate may persist indefinitely (HSDB 1995).
4. Biota — No information was found in the secondary sources searched regarding the transformation/persistence of phosphoric acid in biota. Phosphoric acid is a natural constituent of many fruits and their juices (HSDB 1995).

## CHEMICAL SUMMARY FOR POTASSIUM BISULFATE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of potassium bisulfate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF POTASSIUM BISULFATE		
Characteristic/Property	Data	Reference
CAS No.	7646-93-7	
Common Synonyms	monopotassium sulfate; potassium acid sulfate; potassium bisulphate; sulfuric acid, monopotassium salt	RTECS 1995
Molecular Formula	KHSO <sub>4</sub>	JT Baker Inc. 1992
Chemical Structure	H-O <sub>3</sub> -S-K	RTECS 1995
Physical State	white, deliquescent crystals	Budavari et al. 1989
Molecular Weight	136.17	Budavari et al. 1989
Melting Point	197°C (loses water at higher temperatures, and is converted to pyrosulfate)	Budavari et al. 1989
Boiling Point	decomposes	Fisher Scientific 1991
Water Solubility	soluble in 1.8 parts water; 0.85 parts boiling water	Budavari et al. 1989
Density	2.24	Budavari et al. 1989
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	negligible	Fisher Scientific 1991
Reactivity	0 (nonreactive, NFPA classification); can form an explosive mixture; acidic in solution	Lockheed Martin 1989 Sax and Lewis 1989 Fisher Scientific 1991
Flammability	0 (noncombustible, NFPA classification)	Lockheed Martin 1989a
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data; odorless; sulfur odor	JT Baker Inc. 1992 Fisher Scientific 1991
Conversion Factors	no data	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Potassium bisulfate is a deliquescent solid that is soluble in water. It is used as flux in the analysis of ores, and as a cathartic (Budavari et al. 1989). No data were found on the environmental releases of potassium bisulfate in the secondary sources searched. The chemical is not listed on U.S. EPA's TRI, requiring certain U.S. industries to report on chemical releases to the environment (TRI93 1995).



### **B. Transport**

No data were found on the environmental transport of potassium bisulfate in the secondary sources searched. Low vapor pressure and its water solubility suggest that it would remain in the water phase.

### **C. Transformation/Persistence**

No data were found on the transformation/persistence of potassium bisulfate in the secondary sources searched.

## CHEMICAL SUMMARY FOR POTASSIUM CARBONATE

This chemical was identified by one or more suppliers as a bath ingredient for the carbon, graphite, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of potassium carbonate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF POTASSIUM CARBONATE		
Characteristic/Property	Data	Reference
CAS No.	584-08-7	
Common Synonyms	salt of tartar; pearl ash	Budavari et al. 1989
	potash	RTECS 1995
Molecular Formula	K <sub>2</sub> CO <sub>3</sub>	Budavari et al. 1989
Chemical Structure	K <sub>2</sub> CO <sub>3</sub>	
Physical State	hygroscopic, odorless granules, or granular powder	Budavari et al. 1989
Molecular Weight	138.20	Budavari et al. 1989
Melting Point	891 ° C	Budavari et al. 1989
Boiling Point	no data	
Water Solubility	sol. in 1 part cold, 0.7 pts boiling H <sub>2</sub> O	Budavari et al. 1989
	112 g/100 mL cold water	HSDB 1995
Density	2.29	Budavari et al. 1989
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	hygroscopic; aqueous soln strongly alkaline	Budavari et al. 1989
	violent reaction with ClF <sub>3</sub>	HSDB 1995
Flammability	no data	
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	Budavari et al. 1989
Conversion Factors	no data	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Potassium carbonate is a naturally occurring compound with deposits found in southeastern New Mexico (HSDB 1995). It is one of the major inorganic particle components of cigarette smoke (Churg and Stevens 1992). Potassium carbonate is not one of the compounds reported to the TRI by certain types of U.S. industries.

#### B. Transport

No information was found in the secondary sources searched regarding the transport of potassium carbonate.

### **C. Transformation/Persistence**

No information was found in the secondary sources searched regarding the transformation/persistence of potassium carbonate in air, soil, water, or biota.

## CHEMICAL SUMMARY FOR POTASSIUM AND SODIUM CYANIDE

These chemicals were identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of potassium and sodium cyanide are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF POTASSIUM CYANIDE		
Characteristic/Property	Data	Reference
CAS No.	151-50-8	
Common Synonyms	hydrocyanic acid, potassium salt	RTECS 1995
Molecular Formula	CKN	Budavari et al. 1989
Chemical Structure	KCN	Budavari et al. 1989
Physical State	white deliquescent granular powder or fused pieces	Budavari et al. 1989
Molecular Weight	65.11	Budavari et al. 1989
Melting Point	634°C	Budavari et al. 1989
Boiling Point	no data	
Water Solubility	71.6 g/100 mL at 25°C	ATSDR 1995
Density	1.553 g/cm <sup>3</sup> at 20°C	U.S. EPA 1985c
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	3.0 (calculated)	HSDB 1995
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	slowly decomposed by water and very rapidly by acids to release HCN; pH of 0.1 N solution = 11; incompatible with strong oxidizers such as nitrates, chlorates, and acid salts	HSDB 1995
Flammability	not flammable itself, but contact with acids releases highly flammable HCN gas	HSDB 1995
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	0.3 (calculated)	HSDB 1995
Odor Threshold	faint odor of bitter almonds	ACGIH 1991
Conversion Factors	1 ppm = 2.707 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.369 ppm	U.S. EPA 1985c

## APPENDIX C

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM CYANIDE		
Characteristic/Property	Data	Reference
CAS No.	143-33-9	
Common Synonyms	hydrocyanic acid, sodium salt	RTECS 1995
Molecular Formula	CNaN	Budavari et al. 1989
Chemical Structure	NaCN	Budavari et al. 1989
Physical State	white granules or fused pieces	Budavari et al. 1989
Molecular Weight	49.07	Budavari et al. 1989
Melting Point	563 °C	Budavari et al. 1989
Boiling Point	1500 °C	ACGIH 1991
Water Solubility	freely soluble	Budavari et al. 1989
Density	1.60-1.62 g/cm <sup>3</sup> (temperature not given)	U.S. EPA 1985c
Vapor Density (air = 1)	1.7	JT Baker Inc. 1992b
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	-0.44 (K <sub>ow</sub> )	U.S. EPA 1985c
Vapor Pressure	0.76 mg Hg at 800 °C	U.S. EPA 1985c
Reactivity	contact with acids and acid salts forms HCN immediately; incompatible with strong oxidizers, such as nitrates, chlorates, and acid salts; aqueous solution is strongly alkaline	HSDB 1995
Flammability	not combustible itself, but contact with acids releases highly flammable HCN gas	HSDB 1995
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	0.27 (calculated)	U.S. EPA 1985c
Odor Threshold	faint odor of bitter almonds	HSDB 1995
Conversion Factors	1 ppm = 2.037 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.491 ppm	U.S. EPA 1985c

## II. ENVIRONMENTAL FATE

### A. Environmental Release

Potassium and sodium cyanide are used in the extraction of gold and silver ores; electroplating; metal cleaning; as insecticides and fumigants; in heat treatment of metals; and as raw materials in the manufacture of dyes, pigments, nylon, and chelating agents (ACGIH 1991). In 1993, releases of cyanide compounds to environmental media, as reported to the TRI by certain types of industries, totaled about 3,291,307 pounds. Of this amount, a total of 898,728 pounds was released to the atmosphere, 97,666 pounds to surface waters, 2,288,870 pounds to underground injection, and 6,043 pounds to land (TRI93 1995). Potassium and sodium cyanide are not reported separately.

### B. Transport

Potassium and sodium cyanide release hydrocyanic acid (HCN) to the environment. HCN is expected to volatilize from aquatic media and soils (U.S. EPA 1984c). Cyanide has the potential to be transported in air over long distances from its emission source. Alkali cyanides can be removed from air by both wet and dry deposition (ATSDR 1995). Because of their high water solubility and low sorption characteristics, cyanides are expected to leach through soils into groundwater (U.S. EPA 1985c).

### C. Transformation/Persistence

1. Air — Most cyanide in the atmosphere is likely present as HCN gas, but small amounts of metal cyanides may be present as particulate matter in air. HCN slowly reacts with hydroxyl radicals in the air; the calculated half-life for this reaction is approximately 11 years, indicating no significant loss to the troposphere. Physical transfer, such as wet and dry deposition, may

dominate the fate of cyanides in the atmosphere. Considering the water solubility of alkali cyanides, wet deposition appears to be more important process (U.S. EPA 1984c).

2. Soil — In soils, the fate of cyanides is pH dependent. In acidic soils, the loss of HCN through volatilization may be the predominant mechanism of loss from soil surfaces. In subsurface soils, cyanides that are present at low concentrations (below the toxic levels for microorganisms) may undergo some microbial degradation (U.S. EPA 1984c). Because of their low soil sorption characteristics and high water solubility of cyanides, some may leach through the soil. However, cyanides have been rarely detected in groundwater. In basic soils, the mobility of cyanides is expected to be greatly restricted (U.S. EPA 1984c).
3. Water — The alkali metal salts, such as sodium and potassium cyanide, are very soluble in water and the resulting cyanide ions readily hydrolyze with water to form HCN. The extent of HCN formation is mainly dependent upon water temperature and pH. At 20°C and a pH of 8 or below, at least 96% of free cyanide exists as HCN (U.S. EPA 1980). Since the pH of most natural waters ranges between 6 and 9, a large percentage of cyanides will be present in the form of HCN which readily volatilizes from water. Cyanides can be biodegraded at low concentrations in water by single and mixed organisms. Both aerobic and anaerobic microbial degradation of cyanides during sewage treatment plant operations have been demonstrated (U.S. EPA 1985c).
4. Biota — Potassium and sodium cyanide are not expected to bioaccumulate in aquatic organisms (U.S. EPA 1984c).

## CHEMICAL SUMMARY FOR POTASSIUM HYDROXIDE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, carbon, and non-formaldehyde electroless copper processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of potassium hydroxide are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF POTASSIUM HYDROXIDE		
Characteristic/Property	Data	Reference
CAS No.	1310-58-3	
Common Synonyms	caustic potash; lye; potassium hydrate	HSDB 1995
Molecular Formula	KOH	
Chemical Structure	K-OH	
Physical State	white or slightly yellow lumps, rods, pellets; deliquesces as moisture and carbon dioxide are absorbed from the air	HSDB 1995
Molecular Weight	56.11	HSDB 1995
Melting Point	360 °C	Pierce 1994
Boiling Point	1324 °C	HSDB 1995
Water Solubility	100 g/90 mL; aqueous solution may have pH ≥ 13	HSDB 1995; Pierce 1994a
Density	2.044 mg/mL	HSDB 1995
Vapor Density (air = 1)	not found	
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	not found	
Vapor Pressure	1 mm Hg @ 714 °C	HSDB 1995
pH	14 (1.0 M solution)	Lockheed Martin 1994b
Reactivity	heat generated when KOH dissolves in water, alcohol, or acid-treated solution; reacts violently with <i>O</i> -nitrophenol; heating with tetrachloroethane, 1,2-dichloroethylene, or phosphorus forms spontaneously flammable compounds; explosive when heated or reacted with certain compounds	HSDB 1995
Flammability	will not burn; however, may react with water and other substances and generate heat sufficient to ignite combustible materials	HSDB 1995; NIOSH 1994
Flash Point	not flammable	
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	not found	
Conversion Factors	1 ppm = 2.29 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.44 ppm	Calculated using: ppm = mg/m <sup>3</sup> x 24.45/m.w.

## II. ENVIRONMENTAL FATE

## A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of potassium hydroxide.

**B. Transport**

The significant water solubility of potassium hydroxide suggests that the chemical would be mobile in soil and subject to transport to ground water; however, no evidence was found to confirm this.

**C. Transformation/Persistence**

1. Air — When exposed to air, potassium hydroxide forms the bicarbonate and carbonate (Pierce 1994a).
2. Soil — No information was found in the secondary sources searched regarding the transformation/persistence of potassium hydroxide in soil.
3. Water — No information was found in the secondary sources searched regarding the transformation/persistence of potassium hydroxide in water.
4. Biota — No information was found in the secondary sources searched regarding the transformation/persistence of potassium hydroxide in biota.



## CHEMICAL SUMMARY FOR POTASSIUM PERSULFATE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper and non-formaldehyde electroless copper processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of potassium persulfate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF POTASSIUM PERSULFATE		
Characteristic/Property	Data	Reference
CAS No.	7727-21-1	
Common Synonyms	peroxydisulfuric acid, dipotassium salt; dipotassium persulfate; potassium peroxydisulfate	HSDB 1995
Molecular Formula	$K_2O_8S_2$	Budavari et al. 1989
Chemical Structure	$  \begin{array}{c}  O \quad O \\     \quad    \\  KOSOOSOK \\     \quad    \\  O \quad O  \end{array}  $	
Physical State	colorless or white crystals	Budavari et al. 1989
Molecular Weight	270.32	Budavari et al. 1989
Melting Point	decomposes @ 100°C	Budavari et al. 1989
Boiling Point	no data	
Water Solubility	1.75 g/100 mL @ 0°C; 5.2 g/100 mL @ 20°C	HSDB 1995
Density	2.477	Lide 1991
Vapor Density (air = 1)	no data	
$K_{oc}$	no data	
Log $K_{ow}$	no data	
Vapor Pressure	no data	
Reactivity	powerful oxidizing agent; aqueous solution is acidic	Budavari et al. 1989
Flammability	may ignite other combustible materials; reaction with fuels may be violent; combustion reaction with metallic dust in the presence of moisture	HSDB 1995
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data	
Conversion Factors	no data	

## II. ENVIRONMENTAL FATE

## A. Environmental Release

Potassium persulfate, a crystalline solid, is moderately soluble in water (Budavari et al. 1989). No data on the environmental release of potassium persulfate were found in the secondary sources searched.

**B. Transport**

No information on the transport of potassium persulfate was found in the secondary sources searched. The water solubility of potassium persulfate suggests that the chemical would leach through soil.

**C. Transformation/Persistence**

No information on the transformation/persistence of potassium persulfate in air, soil, water, or biota was found in the secondary sources searched.

## CHEMICAL SUMMARY FOR POTASSIUM SULFATE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of potassium sulfate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF POTASSIUM SULFATE		
Characteristic/Property	Data	Reference
CAS No.	7778-80-5	
Common Synonyms	sulfuric acid, dipotassium salt; dipotassium sulfate	HSDB 1995
Molecular Formula	K <sub>2</sub> SO <sub>4</sub>	Budavari et al. 1989
Chemical Structure	K <sub>2</sub> O <sub>4</sub> S	Budavari et al. 1989
Physical State	colorless or white, hard, bitter crystals; or white granules or powder	Budavari et al. 1989
Molecular Weight	174.26	Budavari et al. 1989
Melting Point	1067°C	Budavari et al. 1989
Boiling Point	1689°C	HSDB 1995
Water Solubility	1 g/8.3 mL	Budavari et al. 1989
Density	2.66	Budavari et al. 1989
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	permanent in air non-reactive	Budavari et al. 1989 JT Baker Inc. 1992c
Flammability	non-flammable	JT Baker Inc. 1992c
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	Budavari et al. 1989
Conversion Factors	no data	

## II. ENVIRONMENTAL FATE

## A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of potassium sulfate. Potassium sulfate is a minor component of pulverized fuel ash (Davison et al. 1986). Potassium sulfate is not one of the chemicals reported to the TRI by certain types of U.S. industries.

## B. Transport

No information was found in the secondary sources searched regarding the transport of potassium sulfate, however it is soluble in water and could be expected to move through the environment.

**C. Transformation/Persistence**

1. Air — Potassium sulfate is water soluble and atmospheric potassium sulfate would be expected to be dissolved in rainwater.
2. Soil — No information was found in the secondary sources searched regarding the transformation/persistence of potassium sulfate in soil.
3. Water — No information was found in the secondary sources searched regarding the transformation/persistence of potassium sulfate in water. Aqueous solutions of potassium sulfate are pH neutral (Budavari et al. 1989).
4. Biota — No information was found in the secondary sources searched regarding the transformation/persistence of potassium sulfate in biota.

### CHEMICAL SUMMARY FOR POTASSIUM SODIUM TARTRATE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

#### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of potassium sodium tartrate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF POTASSIUM SODIUM TARTRATE		
Characteristic/Property	Data	Reference
CAS No.	6381-59-5; 304-59-6; 147-79-5	
Common Synonyms	Rochelle salt; seignette salt	Budavari et al. 1996 HSDB 1996
Molecular Formula	C <sub>4</sub> H <sub>4</sub> KNaO <sub>6</sub>	Budavari et al. 1996
Chemical Structure	no data	
Physical State	translucent crystals of white, crystalline powder	Budavari et al. 1996
Molecular Weight	210.16	Budavari et al. 1996
Melting Point	70-80° C	Budavari et al. 1996
Boiling Point	220° C decomposes	Budavari et al. 1996
Water Solubility	soluble in 0.9 parts H <sub>2</sub> O	Budavari et al. 1996
Density	52% 1.79	Budavari et al. 1996
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	incompatible with acids, calcium or lead salts magnesium sulfate, silver nitrate	Budavari et al. 1996 JT Baker, Inc. 1992d
Flammability	slight	
Flash Point	none	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	EM Industries 1992
Conversion Factors	no data	

#### II. ENVIRONMENTAL FATE

##### A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of potassium sodium tartrate. Potassium sodium tartrate is not one of the chemicals reported to the TRI by certain types of U.S. industries.

##### B. Transport

No information was found in the secondary sources searched regarding the transport of potassium sodium tartrate. It is, however, very soluble in water.

##### C. Transformation/Persistence

No information was found in the secondary sources searched regarding the transformation/persistence of potassium sodium tartrate in air, soil, water, or biota. It is, however, very soluble in water.

## CHEMICAL SUMMARY FOR SILVER

This chemical was identified by one or more suppliers as a bath ingredient for the conductive ink process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of silver are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SILVER		
Characteristic/Property	Data	Reference
CAS No.	7440-22-4	
Common Synonyms	Argentum crede; collargol	U.S. EPA 1996b
Molecular Formula	Ag	ATSDR 1990c
Chemical Structure	Ag; Ag <sup>1+</sup> ; Ag <sup>2+</sup>	ATSDR 1990c
Physical State	Malleable, ductile, white metal	Budavari et al. 1996
Molecular Weight	107.868	Budavari et al. 1996
Melting Point	960.5°C	Budavari et al. 1996
Boiling Point	2212°C @ 760 mm Hg	ATSDR 1990c
Water Solubility	Insoluble	ATSDR 1990c
Density	10.50 g/cm <sup>3</sup> @ 20°C	ATSDR 1990c
Vapor Density (air = 1)	No data	
K <sub>oc</sub>	No data	
Log K <sub>ow</sub>	No data	
Vapor Pressure	100 mm Hg @ 1865°C	ATSDR 1990c
Reactivity	Forms explosive acetylide; forms explosive fulminate compounds with ammonia and with nitric acid + ethanol; reacts violently or produces explosive compounds with bromazide, hydrogen peroxide, ethyleneimine, chlorine, trifluoride, oxalic acid and tartaric acid.	HSDB 1996
Flammability	Moderately flammable as dust	ATSDR 1990c
Flash Point	No data	
Dissociation Constant	No data	
Henry's Law Constant	No data	
Molecular Diffusivity Coefficient	No data	
Air Diffusivity Coefficient	No data	
Fish Bioconcentration Factor	2 - 10	ATSDR 1990c
Odor Threshold	No data	
Conversion Factors	Not applicable, found in air as particulate material	ATSDR 1990c

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Silver is a naturally occurring element that is present in the earth's crust at an average concentration of about 0.1 ppm and at about 0.3 ppm in soils (ATSDR 1990c). It is also present in unpolluted freshwater at concentrations up to 0.5 ppm and in seawater at about 0.01 ppm (HSDB 1996). Silver is released into the environment from mining and recovery processes, and industrial production processes. It is released into the atmosphere during refuse incineration and from burning of coal and petroleum products. Silver and silver compounds are also released from consumer products (ATSDR 1990c). Products and uses include photography, electroplating, electrical conductors, dental alloys, solder and brazing alloys, paints, jewelry, coins, and mirror construction (Faust 1992a). The largest source of silver release through consumer products is photographic material. Silver in the form of silver iodide has been used as cloud seeding material (ATSDR 1990c). Background atmospheric levels of silver measured in national parks away from industrialized areas are generally

less than 0.2 ng/m<sup>3</sup>, however, the concentration can be much higher near smelter plants (up to 36.5 ng/m<sup>3</sup>) or in cloud-seeding target areas (1.0 ng/m<sup>3</sup>) (ATSDR 1990c). Releases into surface waters have resulted in concentrations up to 38 ppm found in the Colorado River, and concentrations as high as 5 ppm in finished drinking water samples. Sediments in the Genesee River in New York downstream from a plant manufacturing photography supplies were found to contain 150 mg silver/kg dry weight (HSDB 1996).

Releases of silver and silver compounds to environmental media in 1993, as reported to the TRI by certain types of U.S. industries totaled about 8608 pounds of elemental silver and 57,168 pounds of silver compounds. Of these amounts, totals of 7080 pounds silver and 21,623 pounds silver compounds were released to the atmosphere, 318 pounds of silver and 9069 pounds of silver compounds were released to surface water, 210 pounds silver and 100 pounds silver compounds were released in underground injection, and 1000 pounds silver and 20,376 pounds of silver compounds were released to land (TRI93 1995).

### B. Transport

Metallic silver released to the atmosphere as particulate material undergoes deposition to land and surface water (ATSDR 1990c). If the particulate material is finely divided (<20 $\mu$  diameter), it can possibly travel long distances before depositing resulting in an enrichment of soil silver levels in areas distant from cloud seeding operations or other sources of airborne silver. Large particles (>20 $\mu$  diameter) such as released during mining operations are deposited near the source (ATSDR 1990c). Transport of silver in surface waters is dependent upon the particular chemical form of the element. Silver can form a number of complexes and salts under certain aquatic conditions of pH and reactant availability. Some compounds precipitate, some adsorb onto particulate matter, and some are soluble and may travel long distances in solution. Up to 90% of the silver detected in rivers was estimated to be in a dissolved form (ATSDR 1990c). Silver tends to be removed from well drained soils; however, the pH, oxidation-reduction potential, and the presence of organic material can affect the mobility. Iron and manganese complexes can immobilize silver, and organic material adsorbs silver (ATSDR 1990c).

### C. Transformation/Persistence

1. Air —Atmospheric silver is in particulate form and is likely to become coated with silver oxide, silver sulfide, or silver carbonate before deposition. Large particles (>20 $\mu$ ) such as released during mining operations are deposited near the source, whereas finer particles (<20 $\mu$  diameter) generated by burning refuse or fossil fuels and by cloud seeding can be carried long distances before being deposited in precipitation (ATSDR 1990c).
2. Soil —Iron and magnesium complexes in the soil tend to immobilize silver and are dependent on pH and oxidation-reduction potential of the soil. Organic matter complexes with silver and also reduces its mobility. The persistence of silver in soils is also dependent on the drainage of the soil and will eventually be removed from well drained soils (ATSDR 1990c).
3. Water —Silver in water exists primarily as the monovalent ion, which can be combined with sulfate, bicarbonate, chloride, and ammonia. It was estimated that about 90% of the silver in rivers is in a dissolved form and the remaining 10% is in suspended solids. Depending on the pH and oxidation-reduction conditions, silver can be adsorbed to manganese oxide, which will eventually be deposited in sediment. It may also become adsorbed onto humic material and suspended particulates. In the presence of decaying animal and plant material, silver precipitates as the sulfide. The sediments in lakes were generally found to be about 1000 times higher in silver concentration than the overlying waters (ATSDR 1990c).

4. Biota —Silver does not tend to bioaccumulate in fish (bioaccumulation factors of 2-10). However, it can be adsorbed by marine algae and accumulated. Bioconcentration factors for marine algae of 13,000 to 66,000 have been calculated (ATSDR 1990c). Silver is absorbed by mussels, clams, and oysters. Bioconcentration factors of 1055 to 7650 have been determined for the marine mussel, *Mytilus edulis*. Biological half-lives of 26.4 and 149.1 days have been estimated for the pacific and American oysters, respectively. It is absorbed from the soil by plant roots and accumulates in the leaves from atmosphere deposition. (ATSDR 1990c).



## CHEMICAL SUMMARY FOR SODIUM BISULFATE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, organic-palladium, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sodium bisulfate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM BISULFATE		
Characteristic/Property	Data	Reference
CAS No.	7681-38-1	
Common Synonyms	sodium acid sulfate; sodium hydrogen sulfate sodium pyrosulfate	Budavari et al. 1989
Molecular Formula	NaHSO <sub>4</sub>	Budavari et al. 1989
Chemical Structure	HNaO <sub>4</sub> S	Budavari et al. 1989
Physical State	Fused, hygroscopic pieces; monohydrate, crystalline	Budavari et al. 1989
Molecular Weight	120.07	Budavari et al. 1989
Melting Point	315 °C	Budavari et al. 1989
Boiling Point	No data	
Water Solubility	50 g/100 mL 100 g/100 mL boiling water	Budavari et al. 1989
Specific Gravity	2.435	Budavari et al. 1989
Vapor Density (air = 1)	No data	
K <sub>oc</sub>	No data	
Log K <sub>ow</sub>	No data	
Vapor Pressure	No data	
Reactivity	Corrosive, water solutions are acidic, decomposes by alcohol to liberate sulfuric acid, SO <sub>2</sub> gas produced when heated to decomposition.	RTECS 1995 Budavari et al. 1989
Flammability	Non-flammable	JT Baker Inc. 1995
Flash Point	No data	JT Baker Inc. 1995
Dissociation Constant	No data	
Henry's Law Constant	No data	
Molecular Diffusivity Coefficient	No data	
Air Diffusivity Coefficient	No data	
Fish Bioconcentration Factor	No data	
Taste Threshold	No data	
Odor Threshold	Odorless	JT Baker Inc. 1995
Conversion Factors	Not applicable, material contained in water aerosol or present as dust	

## II. ENVIRONMENTAL FATE

## A. Environmental Release

Sodium bisulfate is manufactured for use as a solubilizer for minerals, for pickling metals, carbonizing wool, bleaching and swelling leather, and in the manufacture of magnesia cements (Budavari et al. 1989). It is also used in the agricultural industry as a disinfectant (RTECS 1995). The total number of individuals occupationally exposed to sodium bisulfate in a National Occupational Exposure Survey in 1983 was 151,380 (RTECS 1995).

**B. Transport**

No information on the transport of sodium bisulfate was found in the secondary sources searched. In areas where the chemical is used, it has been found in airborne dusts and in water aerosols (JT Baker Inc. 1995; Utell et al. 1982). Due to its high water solubility, about 50 g/100 mL (Budavari et al. 1989), transport by water is a possibility.

**C. Transformation/Persistence**

1. Air — No information on the transformation/persistence of sodium bisulfate was found in the secondary sources searched. Aerosols and dusts in industrial settings are controlled by exhaust ventilation (JT Baker Inc. 1995).
2. Soil — Specific studies on the transformation/persistence of sodium bisulfate in the soil were not found in the secondary sources searched; however, sodium bisulfate is likely to rapidly leach from the soil into ground water because of its high solubility. It is a non-volatile solid and should not volatilize into the atmosphere from the soil, although it may become airborne in dust (JT Baker Inc. 1995).
3. Water — No studies on the transformation/persistence of sodium bisulfate in water were found in the secondary sources searched. Sodium bisulfate is strongly acidic in water solution (Budavari et al. 1989) and, therefore, is subject to neutralization and salt formation by water soluble cations.
4. Biota — No information on the transformation/persistence of sodium bisulfate in biota was found in the secondary sources searched. The water solubility and acidity of sodium bisulfate in solution make bioconcentration unlikely.

## CHEMICAL SUMMARY FOR SODIUM CARBONATE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, conductive polymer, and organic-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sodium carbonate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM CARBONATE		
Characteristic/Property	Data	Reference
CAS No.	497-19-8	
Common Synonyms	carbonic acid, disodium salt; disodium carbonate; soda ash; trona; Solvay soda	RTECS 1995
Molecular Formula	$\text{CNa}_2\text{O}_3$	Budavari et al. 1989
Chemical Structure	$\text{Na}_2\text{CO}_3$	Budavari et al. 1989
Physical State	white hygroscopic powder	Pierce 1994b
Molecular Weight	106.0	Budavari et al. 1989
Melting Point	851 °C, but begins to lose $\text{CO}_2$ @ 400 °C	Budavari et al. 1989
Boiling Point	decomposes	Pierce 1994b
Water Solubility	7.1 g/100 mL water @ 0 °C; 45.5 g/100 mL @ 100 °C	Pierce 1994b
Density	2.53 @ 20 °C	Pierce 1994b
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	decomposed by acids with effervescence; combines with water with evolution of heat; 1% aqueous solution has pH of 11.5	Budavari et al. 1989 Pierce 1994b
Flammability	noncombustible	HSDB 1995
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	Budavari et al. 1989
Conversion Factors	not applicable	

## II. ENVIRONMENTAL FATE

## A. Environmental Release

Sodium carbonate is a white hygroscopic powder that is strongly caustic (Pierce 1994b). It is moderately soluble in water (Budavari et al. 1989). It is usually encountered as the decahydrate ( $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ), commonly called washing soda or soda ash (Pierce 1994b). Sodium carbonate occurs naturally in large deposits in Africa and the U.S. as either the carbonate or trona, a mixed ore of equal molar amounts of carbonate and bicarbonate (Pierce 1994b). Naturally occurring hydrates include the monohydrate, thermonitrite, and the decahydrate, natron or natrite (Budavari et al. 1989). Sodium carbonate is used in the manufacture of glass and sodium salts; in soaps and strong cleansing agents; water softeners; pulp and paper manufacture; textile treatments; and various chemical

processes. Sodium carbonate is not listed on the U.S. EPA's TRI, requiring certain U.S. industries to report on chemical releases to the environment (TRI93 1995).

**B. Transport**

No information on the transport of sodium carbonate was found in the secondary sources searched. The water solubility suggests that the chemical would leach through soil.

**C. Transformation/Persistence**

No information on the transformation/persistence of sodium carbonate was found in the secondary sources searched. The water solubility suggests that the chemical would remain in the aqueous phase.

## CHEMICAL SUMMARY FOR SODIUM CHLORIDE

This chemical was identified by one or more suppliers as a bath ingredient for the tin-palladium process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sodium chloride are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM CARBONATE		
Characteristic/Property	Data	Reference
CAS No.	7647-14-5	
Common Synonyms	table salt, rock salt, sea salt, halite	Budavari et al. 1996; HSDB 1996
Molecular Formula	NaCl	Budavari et al. 1996
Chemical Structure	Cl - Na	Budavari et al. 1996
Physical State	Cubic white crystals, granules, or powder, colorless and transparent or translucent when in large crystals	Budavari et al. 1996
Molecular Weight	58.44	Budavari et al. 1996
Melting Point	804 °C, 801 °C, 804-1600 °C	Budavari et al. 1996; Chapman and Hall 1996; Perry et al. 1994
Boiling Point	1413 °C	Chapman and Hall 1996
Water Solubility	1 g/2.8 mL water @ 25 °C 35.7 g/100 cm <sup>3</sup> @ 0 °C 39.12 g/100 cm <sup>3</sup> @ 100 °C	Budavari et al. 1996; Chapman and Hall 1996; Lide 1991
Density	2.165 g/mL @ 25 °C	Lide 1991
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub> (= Log P <sub>oct</sub> )	no data	
Vapor Pressure	1 mm Hg @ 865 °C	Sax and Lewis 1989
Reactivity	Reacts violently with BrF <sub>3</sub> and lithium.	Sax and Lewis 1989
Flammability	non-flammable	NTP 1996
Flash Point	non-combustible	HSDB 1996
Dissociation Constant	no data	
Air Diffusivity Constant	no data	
Molecular Diffusivity Constant	no data	
Henry's Law Constant	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data	
Conversion Factors	no data	

## II. ENVIRONMENTAL FATE

## A. Environmental Release

Sodium chloride (NaCl) occurs in nature as the mineral halite (i.e. salt deposits) and is dissolved in the ocean (2.6% concentration) and other bodies of water (HSDB 1996). It is produced by mining, evaporation of brine from underground salt deposits, and evaporation from sea water (Budavari et al. 1996). It is released artificially into the environment as waste from bake houses and pickling and canning factories, etc., and in its use as a snow antifreeze or de-icer on pathways (HSDB 1996).

**B. Transport**

No information was found on the environmental transport of sodium chloride in the secondary sources searched. Its high water solubility (1 g/2.8 mL water @ 25 °C, Budavari et al. 1996) suggests that if it were released into the soil it would be highly mobile (e.g. when dissolved in rainfall) and could eventually end up in the groundwater.

**C. Transformation/Persistence**

1. Air — No information was found on the transformation/persistence of sodium chloride in air in the secondary sources searched. Its low reactivity and volatility (HSDB 1996, Sax and Lewis 1989) and high water solubility (Chapman and Hall 1996) indicate that any sodium chloride released into the air (e.g. from salt mining) would either dissolve in air moisture or remain as unchanged particulates that settle out.
2. Soil — Sodium chloride is found naturally in the soil as underground rock salt deposits. These salt deposits can be dissolved in water because NaCl is highly water soluble (Chapman and Hall 1996, Lide 1991). The dissolved sodium chloride can then be either recovered above ground, as in solution mining (Perry et al. 1994), or may possibly end up in the groundwater (further information was not located in the searched secondary sources).
3. Water — Sodium chloride is very soluble in water, being stable in solution for at least 24 hours at room temperature (NTP 1996, Chapman and Hall 1996, Lide 1991). No other relevant information was located in the secondary sources searched.
4. Biota — No information was found on the transformation/persistence of sodium chloride in the biota in the secondary sources searched. Its high water solubility indicates that it would not appreciably bioconcentrate in the flora or fauna.

## CHEMICAL SUMMARY FOR SODIUM CHLORITE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper and non-formaldehyde electroless copper processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sodium chlorite are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM CHLORITE		
Characteristic/Property	Data	Reference
CAS No.	7758-19-2	
Common Synonyms	chlorous acid, sodium salt; Textone	HSDB 1995
Molecular Formula	ClNaO <sub>2</sub>	Budavari et al. 1989
Chemical Structure	NaClO <sub>2</sub>	Budavari et al. 1989
Physical State	slightly hygroscopic crystals or flakes	Budavari et al. 1989
Molecular Weight	90.45	Budavari et al. 1989
Melting Point	decomposes at 180-200°C	Budavari et al. 1989
Boiling Point	no data	
Water Solubility	390 g/L at 17°C; 550 g/L at 60°C	Budavari et al. 1989
Density	2.468 g/m <sup>3</sup>	HSDB 1995
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	negligible	Eastman Kodak 1986
Reactivity	powerful oxidizer, but will not explode on percussion unless in contact with oxidizable material; in aqueous alkaline solution, chlorite ion is very stable; in acid solution, chlorite forms chlorous acid (HClO <sub>2</sub> ), which rapidly forms chlorine dioxide (ClO <sub>2</sub> ), chlorate, and chloride	Budavari et al. 1989
Flammability	fire hazard rating = 1; slightly combustible	IARC 1991 Lockheed Martin 1994c
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data	
Conversion Factors	not applicable	

## II. ENVIRONMENTAL FATE

## A. Environmental Release

Most of the sodium chlorite used in the U.S. is in the production of aqueous chlorine dioxide solutions at the site of use. The conversion can be carried out by the disproportionation of chlorous acid formed from chlorite in aqueous hydrochloric acid solution, but is more commonly achieved by the oxidation of chlorite by chlorine or hypochlorous acid (IARC 1991). Chlorine dioxide is generated to bleach and strip textiles; to bleach wood pulp in paper processing; to eliminate tastes and odors in drinking water; to reduce loads of adsorbable organic halogenated compounds in industrial effluents; to control microbiological growth in paper mills, oil wells, petroleum systems, and food processing flume water; to bleach fats and oils; to disinfect sewage; to treat factory wastes;

to bleach natural foliage; and to control algae in industrial cooling towers. Sodium chlorite is also used in the electronics industry for etching. It is not known to occur naturally (IARC 1991).

Sodium chlorite is used in a small number of water treatment plants to generate chlorine dioxide; this may result in a low residual concentration of chlorite in drinking water (IARC 1991). Sodium chlorite is not listed on U.S. EPA's TRI, requiring certain U.S. industries to report on chemical releases to the environment (TRI93 1995).

**B. Transport**

No information on the transport of sodium chlorite was found in the secondary sources searched.

**C. Transformation/Persistence**

No information on the transformation/persistence of sodium chlorite was found in the secondary sources searched.



## CHEMICAL SUMMARY FOR SODIUM HYDROXIDE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, conductive polymer, non-formaldehyde electroless copper, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sodium hydroxide are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM HYDROXIDE		
Characteristic/Property	Data	Reference
CAS No.	1310-73-2	
Common Synonyms	caustic soda; soda lye	Budavari et al. 1989
Molecular Formula	NaOH	Budavari et al. 1989
Chemical Structure	NaOH	Budavari et al. 1989
Physical State	deliquescent solid	Lide 1991
Molecular Weight	40.01	Budavari et al. 1989
Melting Point	318°C	Budavari et al. 1989
Boiling Point	1390°C	Lide 1991
Water Solubility	1 g in 0.9 mL water, 0.3 mL boiling water	Budavari et al. 1989
Density	2.13 g/mL @ 25°C	Budavari et al. 1989
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	too low to be measured	HSDB 1995
Vapor Pressure	1 mm Hg @ 739°C	Sax 1984
Reactivity	reacts with all mineral acids to form the corresponding salts; with organic acids to form soluble salts; pH of 0.5% solution is about 13	HSDB 1995 Budavari et al. 1989
Flammability	not combustible but solid form in contact with moisture or water may generate sufficient heat to ignite combustible materials	HSDB 1995
Flash Point	no data	
Dissociation Constant	dissociates completely	HSDB 1995
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	HSDB 1995
Conversion Factors	1 mg/m <sup>3</sup> = 0.61 ppm; 1 ppm = 1.636 mg/m <sup>3</sup>	calculated: mg/m <sup>3</sup> = 1 ppm x MW/24.45

## II. ENVIRONMENTAL FATE

## A. Environmental Release

Sodium hydroxide is a corrosive deliquescent solid available in various solid forms and as solutions, usually 45-75% in water. It is a strong alkali that is highly soluble in water (Budavari et al. 1989). When the chemical is dissolved in water, mists are frequently formed and heat is released (Pierce 1994b). As the least expensive strong base, sodium hydroxide is widely employed in industries such as rayon, cellophane and textiles, pulp and paper, soap and detergents, etching and electroplating, and many others (ACGIH 1991). Although sodium hydroxide releases are expected to occur in industrial/occupational settings, no data were found in the secondary sources searched. Consumers may be exposed to oven cleaning products that contain >5% lye (HSDB 1995).

**B. Transport**

No information on the transport of sodium hydroxide was found in the secondary sources searched. Because of its low vapor pressure, sodium hydroxide is not expected to partition to the atmosphere in significant amounts. The water solubility suggests that sodium hydroxide would leach through soil.

**C. Transformation/Persistence**

No information on the transformation/persistence of sodium hydroxide was found in the secondary sources searched. Low vapor pressure and its water solubility suggest the chemical would remain in the aqueous phase.

## CHEMICAL SUMMARY FOR SODIUM HYPOPHOSPHITE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1. The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sodium hypophosphite are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM HYPOPHOSPHITE		
Characteristic/Property	Data	Reference
CAS No.	7681-53-0	
Common Synonyms	phosphinic acid, sodium salt	Budavari et al. 1989
Molecular Formula	$\text{H}_2\text{NaO}_2\text{P}$	Budavari et al. 1989
Chemical Structure	$\text{H}_2\text{-O}_2\text{-P-Na}$	RTECS 1995
Physical State	white granules	Budavari et al. 1989
Molecular Weight	87.97	Budavari et al. 1989
Melting Point	no data	
Boiling Point	no data	
Water Solubility	100 g/100 mL at 25 °C	Weast 1983-1984
Density	no data	
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	explodes when triturated with chlorates or other oxidizing agents; explosive when heated; mixture with sodium or potassium nitrate is powerful explosive	Budavari et al. 1989 HSDB 1995
Flammability	decomposes when heated forming phosphine, a spontaneously flammable gas	HSDB 1995
Flash Point	phosphine is spontaneously flammable	HSDB 1995
Dissociation Constant	no data; aqueous solution is neutral	Budavari et al. 1989
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	Budavari et al. 1989
Conversion Factors	1 ppm = 3.60 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.28 ppm	Calculated using: mg/m <sup>3</sup> = ppm × MW/24.45

## II. ENVIRONMENTAL FATE

## A. Environmental Release

No information was found regarding the release of sodium hypophosphite to the environment. The chemical could potentially enter the environment from its use in removing mercury from animal feeds and manures or as an antimicrobial agent in meat, poultry, and fish (HSDB 1995). Sodium hypophosphite is not listed by the TRI requiring certain types of U.S. industries to report environmental releases (TRI93 1995).

**B. Transport**

No information was found in the secondary sources searched regarding the movement of sodium hypophosphite through environmental media. Based on the high water solubility, the chemical could be expected to be found in the aqueous phase.

**C. Transformation/Persistence**

No information was found in the secondary sources searched regarding the transformation/persistence of sodium hypophosphite in the air, soil, water, or biota.

## CHEMICAL SUMMARY FOR SODIUM HYPOPHOSPHITE 1-HYDRATE

This chemical was identified by one or more suppliers as a bath ingredient for the organic-palladium process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sodium hypophosphite 1-hydrate are summarized below.

#### CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM HYPOPHOSPHITE 1-HYDRATE

Characteristic/Property	Data	Reference
CAS No.	10039-56-2	
Common Synonyms	sodium phosphinate hydrate; phosphinic acid, sodium salt, monohydrate	Lockheed Martin 1995b
Molecular Formula	$H_4NaPO_3$	CHEMFINDER 1996
Chemical Structure	$NaH_2PO_2 \cdot H_2O$	CHEMFINDER 1996
Physical State	white crystals	EM Industries 1991
Molecular Weight	105.99	CHEMFINDER 1996
Melting Point	230°C (decomposes)	EM Industries 1991
Boiling Point	no data	
Water Solubility	50% 100 g/100 mL	EM Industries 1991 Chapman and Hall 1995
Density	0.8	EM Industries 1991
Vapor Density (air = 1)	3.6	CHEMFINDER 1996
$K_{oc}$	no data	
Log $K_{ow}$	no data	
Vapor Pressure	no data	
Reactivity	react violently with strong oxidizing agents	EM Industries 1991
Flammability	gives off toxic gases when burned	CHEMFINDER 1996
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	JT Baker Inc. 1994
Conversion Factors	no data	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

No information was found in the secondary sources searched on the amount or sources of sodium hypophosphite 1-hydrate released to the environment.

#### B. Transport

No information was found in the secondary sources searched to indicate how sodium hypophosphite 1-hydrate is transported in the environment. The high water solubility suggests that leaching into groundwater could occur.

#### C. Transformation/Persistence

No information was found in the secondary sources searched regarding the transformation or persistence of sodium hypophosphite 1-hydrate in air, soil, water, or biota.

## CHEMICAL SUMMARY FOR SODIUM PERSULFATE

This chemical was identified by one or more suppliers as a bath ingredient for the carbon, graphite, organic-palladium, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sodium persulfate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM PERSULFATE		
Characteristic/Property	Data	Reference
CAS No.	7775-27-1	
Common Synonyms	sodium peroxydisulfate peroxydisulfuric acid, disodium salt disodium peroxydisulfate	Budavari et al. 1989 RTECS 1995 DuPont and Co. 1992
Molecular Formula	Na <sub>2</sub> S <sub>2</sub> O <sub>8</sub>	Budavari et al. 1989
Chemical Structure	Na <sub>2</sub> O <sub>8</sub> S <sub>2</sub>	Budavari et al. 1989
Physical State	white crystalline powder	Budavari et al. 1989
Molecular Weight	238.13	Budavari et al. 1989
Melting Point	no data	
Boiling Point	no data	
Water Solubility	549 g/L @ 20°	Budavari et al. 1989
Density	2.4	JT Baker Inc. 1985
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	gradually decomposes; decomposition promoted by H <sub>2</sub> O and high temperature strong oxidizer. Contact with other material may cause fire. Can react violently with shock, friction, or heat	Budavari et al. 1989 JT Baker Inc. 1985
Flammability	slightly combustible	Lockheed Martin 1989b
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless	JT Baker Inc. 1985
Conversion Factors	1 mg/m <sup>3</sup> = 0.10 ppm 1 ppm = 9.74 mg/m <sup>3</sup>	Calculated using: ppm = mg/m <sup>3</sup> × 24.45/mol. wt.

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of sodium persulfate.

#### B. Transport

No information was found in the secondary sources searched regarding the transport of sodium persulfate.

### **C. Transformation/Persistence**

No information was found in the secondary sources searched regarding the transformation/persistence of sodium persulfate in air, soil, water, or biota.

## CHEMICAL SUMMARY FOR SODIUM SULFATE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sodium sulfate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM SULFATE		
Characteristic/Property	Data	Reference
CAS No.	7757-82-6	
Common Synonyms	bisodium sulfate; disodium monosulfate disodium sulfate; sulfuric acid disodium salt	HSDB 1995
Molecular Formula	Na <sub>2</sub> SO <sub>4</sub>	HSDB 1995
Chemical Structure	H <sub>2</sub> -O <sub>2</sub> -S <sub>2</sub> Na	HSDB 1995
Physical State	white powder or orthorhombic bipyramidal crystals	HSDB 1995
Molecular Weight	142.06	HSDB 1995
Melting Point	888°C	HSDB 1995
Boiling Point	not found	
Water Solubility	soluble in about 3.6 parts H <sub>2</sub> O	HSDB 1995
Density	2.671	HSDB 1995
Vapor Density (air = 1)	not found	
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	not found	
Vapor Pressure	not found	
Reactivity	sodium sulfate and aluminum will explode at 800°C; reacts violently with magnesium	HSDB 1995
Flammability	not found	
Flash Point	nonflammable	HSDB 1995
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	odorless	HSDB 1995
Conversion Factors	1 ppm = 5.81 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.172 ppm	Calculated using: ppm = mg/m <sup>3</sup> x 24.45/m.w.

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Sodium sulfate occurs in nature in the minerals mirabilite, thenardite, hanksite, sulphohalite, galubzrite, loeweite, ferronatrite, bloedite, tychite, apthitalite, tamarugite, and mendozite; it is relatively common in alkali lakes, ground water, and sea water (HSDB 1995).

An analysis of individual droplets in samples of fog, haze and cloud collected in Israel revealed the presence of both acid and alkaline droplets (Ganor et al. 1993). The alkaline droplets contained minerals and salt solutions of sodium sulfate, calcium sulfate or sodium chloride.

#### B. Transport

No information was found in the secondary sources searched regarding the environmental transport of sodium sulfate.



### C. Transformation/Persistence

1. Air — No information was found in the secondary sources searched regarding the transformation/persistence of sodium sulfate in air. HSDB (1995) states that sodium sulfate may persist indefinitely in the environment.
2. Soil — No information was found in the secondary sources searched regarding the transformation/persistence of sodium sulfate in soil. HSDB (1995) states that sodium sulfate may persist indefinitely in the environment.
3. Water — No information was found in the secondary sources searched regarding the transformation/persistence of sodium sulfate in the aquatic environment. HSDB (1995) states that sodium sulfate may persist indefinitely in the environment.
4. Biota — There is no evidence that sodium sulfate accumulates in biota or contaminates the food chain (HSDB 1995).

## CHEMICAL SUMMARY FOR STANNOUS CHLORIDE AND STANNOUS CHLORIDE AS TIN

These chemicals were identified by one or more suppliers as a bath ingredient for the electroless copper, non-formaldehyde electroless copper, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of stannous chloride are summarized below. The valence state of the stannous ion is 2 ( $\text{Sn}^{2+}$  or  $\text{Sn}[\text{II}]$ ).

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF STANNOUS CHLORIDE		
Characteristic/Property	Data	Reference
CAS No.	7772-99-8	
Common Synonyms	tin (II) chloride tin dichloride tin protochloride	HSDB 1995
Molecular Formula	$\text{SnCl}_2$	
Chemical Structure	$\text{SnCl}_2$	
Physical State	crystals or flakes	Budavari et al. 1989
Molecular Weight	189.61	Budavari et al. 1989
Melting Point	246°C	Lide 1991
Boiling Point	652°C at 720 mm Hg	Lide 1991
Water Solubility	900 g/L at 20°C	HSDB 1995
Density	$d^{25}_4$ 3.95	Lide 1991
Vapor Density (air = 1)	no data	
$K_{oc}$	no data	
Log $K_{ow}$	-2 to -3	Wong et al. 1982
Vapor Pressure	no data	
Reactivity	powerful reducing agent	Budavari et al. 1989
Flammability	not readily flammable	HSDB 1995
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	3000 (inorganic tin) <sup>a</sup>	ATSDR 1992
Odor Threshold	odorless	HSDB 1995
Conversion Factors	not applicable	

a) Method of calculation/measurement not given.

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

No data on the release of stannous chloride to the environment were located in the secondary sources searched; environmental levels of tin are stated in terms of inorganic tin. Tin is a naturally-occurring element found in environmental media and natural foods. Tin and tin compounds are not included in the TRI. The most significant releases of inorganic tin are from burning of fossil fuels and industrial production and use of tin (ATSDR 1992). The tin content of airborne fly ash from coal-burning plants ranged from 7-19  $\mu\text{g/g}$  (ATSDR 1992). Tin in waste streams originates primarily from the production of tin cans (Brown 1983, as reported in HSDB 1995). Tin also occurs in water stored in coated metal containers and may be released in effluents from industrial processes and from municipal sewage (NRC 1977). Human exposure to tin is primarily by ingestion of canned food products (ATSDR 1992).

Public water supplies in 42 U.S. cities contained total tin at concentrations of 1.1-2.2 ug/L; water from 175 natural sources in west-central Arkansas contained 0.9-30 ug/L total tin (NRC 1977). Total tin was below the limit of detection in 56 of 59 samples of river water in the U.S. and Canada; the other three values were 1.3, 1.4, and 2.1 ug/L (NRC 1977). Seawater contains 0.2-0.3 ug/L (NRC 1977). Tin occurs in surface and groundwater at 21% of NPL sites at a geometric mean concentration of 50 ug/L (ATSDR 1992). Ambient soil levels in Canada ranged from 1-200 mg/kg total tin (mean 4 mg/kg); the ambient sediment level was 4.6 mg/kg (HSDB 1995). Tin was detected at hazardous waste sites at a geometric mean concentration of 30 mg/kg of soil (ATSDR 1992).

### B. Transport

Tin released to the atmosphere in the form of particulates would be removed by gravitational settling within a matter of days. In soil, the  $\text{Sn}^{2+}$  cation will be adsorbed to some extent. Although moderately water soluble, tin in water may partition to soils and sediments; the  $\text{Sn}^{2+}$  ion will also readily precipitate as a sulfide or hydroxide (ATSDR 1992). These characteristics would limit mobility.

### C. Transformation/Persistence

1. Air — Tin in the atmosphere is usually associated with dust particles; the deposition half-life of dust particles is on the order of days (U.S. EPA 1987c). No information on the transformation or degradation of inorganic tin compounds in the atmosphere was found.
2. Soil — The  $\text{Sn}^{2+}$  cation will be adsorbed by soil to some extent (ATSDR 1992), thereby retarding leaching to groundwater. The formation of insoluble salts would also limit the amount leaching to groundwater.
3. Water —  $\text{Sn}^{2+}$  in oxygen poor alkaline water will readily precipitate as a sulfide or hydroxide (ATSDR 1992); this would limit the amount in solution or suspension in groundwater. Inorganic tin may be transformed into organometallic compounds; a change of valence state probably does not occur (ATSDR 1992).
4. Biota — A log  $K_{ow}$  of -2 to -3 would indicate little potential for bioaccumulation, but reported estimates of the bioconcentration factors for inorganic tin (valence state not given) for marine and freshwater plants, invertebrates, and fish were 100, 1000, and 3000, respectively (ATSDR 1992).

## CHEMICAL SUMMARY FOR SULFURIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper, carbon, conductive polymer, graphite, non-formaldehyde electroless copper, and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sulfuric acid are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SULFURIC ACID		
Characteristic/Property	Data	Reference
CAS No.	7664-93-9	
Common Synonyms	sulphuric acid; oil of vitriol	HSDB 1995
Molecular Formula	H <sub>2</sub> SO <sub>4</sub>	Budavari et al. 1989
Chemical Structure	$  \begin{array}{c}  \text{O} \\     \\  \text{HO} - \text{S} - \text{OH} \\     \\  \text{O}  \end{array}  $	
Physical State	clear, colorless, odorless, oily liquid	Budavari et al. 1989
Molecular Weight	98.08	Budavari et al. 1989
Melting Point	10°C (anhydrous acid)	Budavari et al. 1989
Boiling Point	about 290°C; decomposes at 340°C	Budavari et al. 1989
Water Solubility	miscible with water	Budavari et al. 1989
Density	1.84 (96-98% acid)	NIOSH 1994
Vapor Density (air = 1)	3.4 (at boiling point)	HSDB 1995
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	5.933 x 10 <sup>-5</sup> @ 25 mm Hg	CHEMFATE 1995
Reactivity	strong dehydrating agent; reacts violently with water with evolution of heat; corrosive to metals	ACGIH 1991 ACGIH 1994-1995
Flammability	not flammable, but capable of igniting finely divided combustible materials	HSDB 1995
Flash Point	no data	
Dissociation Constant	K = 1.2 x 10 <sup>-2</sup> ; pK = 1.92	HSDB 1995
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	1 mg/m <sup>3</sup>	HSDB 1995
Conversion Factors	1.2 mg H <sub>2</sub> SO <sub>4</sub> contains 1 mg of SO <sub>3</sub> ; 1 mg SO <sub>3</sub> = 0.3 ppm; 1 ppm = 3.2 mg/m <sup>3</sup> @ 25°C, 760 mm Hg	Beliles and Beliles 1993

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Sulfuric acid is a clear, colorless, odorless, oily liquid. It has a high affinity for water, abstracting it from the air and many organic substances. Sulfuric acid is produced in numerous grades and strengths. Commercial sulfuric acid contains 93-98% of acid; the remainder is water (Budavari et al. 1989). The primary sources of sulfuric acid in the atmosphere are vehicular emissions, combustion sources, explosive manufacture, furnace soot, sulfuric acid manufacture, and steel manufacture (U.S. EPA 1984d). Sulfuric acid occurs naturally in the vicinity of volcanoes, particularly in volcanic gases (HSDB 1995). Sulfur dioxide in moist air or fog combines with the water to form sulfurous

acid; the latter is slowly oxidized to sulfuric acid (Beliles and Beliles 1993). Based on rain chemistry data measured in southwestern Pennsylvania in 1983, an acid deposition budget was estimated as follows: 47%, sulfuric acid in rain; 23%, sulfur dioxide deposition without dew; 16%, nitric acid and sulfuric acid in fog and dew; and 0.5% aerosol dry deposition without dew (HSDB 1995).

Sulfuric acid can enter the aquatic environment from a variety of sources: in accidental spills from train derailments; in wastewaters from mining properties where sulfides are part of the ore or the rock being mined; in wastewaters from the steel industry; from the atmosphere; and as a decomposition product of effluents containing sulfur, thiosulfate, or thionates (HSDB 1995).

Sulfuric acid is the most widely used of the strong inorganic acids. Average occupational exposures to sulfuric acid mists in pickling, electroplating, and other acid treatment of metals are frequently above 0.5 mg/m<sup>3</sup>, while lower levels are usually found in the manufacture of lead-acid batteries and in phosphate fertilizer production (IARC 1992).

In 1992, releases of sulfuric acid to environmental media, as reported to the TRI by certain types of industries, totaled about 156,809,406 pounds. Of this amount, 23,721,453 pounds (15%) were released to the atmosphere, 32,719,526 pounds (21%) were released to surface water, 98,631,395 pounds (63%) were released in underground injection sites, and 1,737,032 pounds (1%) were released on land (TRI92 1994).

### B. Transport

Sulfuric acid aerosols in the atmosphere are likely to be removed through wet and dry deposition. Released to soils, most of the sulfuric acid is expected to be removed by reaction with inorganic minerals or organic matter in soils. In highly sandy soil, sulfuric acid probably leaches into groundwater (U.S. EPA 1984d).

### C. Transformation/Persistence

1. Air — Sulfuric acid is present in the atmosphere in the form of aerosols. In dry weather, the aerosol is found in the sub-0.65  $\mu\text{m}$  particle size fraction, while under humid conditions, it is present in the 0.65-3.6  $\mu\text{m}$  particle size range. Sulfuric acid is a primary source of inorganic sulfates in the atmosphere, particularly ammonium sulfate. Depending on the amount of moisture in the atmosphere, sulfuric acid aerosols may react with organics in the atmosphere to form sulfonates.
2. Soil — The majority of sulfuric acid in soils is expected to be removed by reaction with inorganic minerals or organic matter in soils. During transport through the soil, sulfuric acid can dissolve some of the soil material, in particular carbonate-based materials (HSDB 1995). In highly sandy soil, sulfuric acid probably leaches into groundwater (U.S. EPA 1984d).
3. Water — In aquatic media of about pH >7, sulfuric acid reacts with carbonate, bicarbonate, or hydroxides in the sediment or suspended particles, with the formation of sulfates. Since the majority of sulfates, with the exception of lead and calcium, are soluble in water, this reaction may mobilize the precipitated metals from the aquatic phase and decrease the pH of the solution. In aquatic media of pH <7, at least a part of the sulfuric acid may remain ionized in solution and may be mobile (U.S. EPA 1984d).
4. Biota — No information on the transformation/persistence of sulfuric acid in biota was found in the secondary sources searched.

## CHEMICAL SUMMARY FOR TARTARIC ACID

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of tartaric acid are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF TARTARIC ACID		
Characteristic/Property	Data	Reference
CAS No.	87-69-4	
Common Synonyms	2,3-dihydroxybutanedioic acid; L-tartaric acid; Budavari et al. 1996; d-trataric acid; natural tartaric acid	Katz and Guest 1994, L-threonic acid; Informatics, Inc. 1974
Molecular Formula	C <sub>4</sub> H <sub>6</sub> O <sub>6</sub>	Budavari et al. 1996
Chemical Structure	HO <sub>2</sub> CCH(OH)CH(OH)CO <sub>2</sub> H	Lide 1991
Physical State	colorless or translucent solid monoclinic rhombic or spheroidal prisms, a white fine to granular crystalline powder	Lide 1991; Budavari et al. 1996
Molecular Weight	150.09	Informatics, Inc. 1974
Melting Point	171-174 °C; 168-170 °C	Lide 1991
Boiling Point	no data	Budavari et al. 1996
Water Solubility	freely soluble (139 g/100 mL @ 20 °C)	Informatics, Inc. 1974
Density	1.7598 @ 20 °C	Lide 1991
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>OW</sub> (= Log P <sub>oct</sub> )	Log P <sub>oct</sub> -0.76/-2.02 (calculated) for the racemic threonic acid	Verschueren 1983
Vapor Pressure	no data	
Reactivity	no data	
Flammability	no data	
Flash Point	no data	
Dissociation Constant	pK <sub>a1</sub> = 2.98, pK <sub>a2</sub> = 4.34 pK <sub>a1</sub> = 2.93, pK <sub>a2</sub> = 4.23	Chapman and Hall 1996 Katz and Guest 1994, Budavari et al. 1996
Air Diffusivity Constant	no data	
Molecular Diffusivity Constant	no data	
Henry's Law Constant	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	odorless; odor of burnt sugar when heated to melting point	Informatics, Inc. 1974; Budavari et al. 1996
Conversion Factors	no data	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

No information on environmental releases of tartaric acid was found in the secondary sources searched. Tartaric acid is widely used in foods, soft drinks, wine, cleaners, textile printing, pharmaceuticals, etc. and is freely water-soluble, so small quantities are likely to be released into the water supply, soil and eventually the groundwater from personal and commercial use and production.

### **B. Transport**

No information on the environmental transport of tartaric acid was found in the secondary sources searched. Its high water solubility (139 g/100 mL @ 20°C; Budavari et al. 1996) suggests that if it did volatilize it could be removed from the atmosphere by rainfall, and if it were released onto soil it would likely be mobile and may end up in the groundwater.

### **C. Transformation/Persistence**

1. Air – Tartaric acid is reported to be stable to air and light (Budavari et al. 1996); no other information was found in the secondary sources searched.
2. Soil – No information regarding the transformation/persistence of tartaric acid in soil was located. Its high water solubility suggests it would be highly mobile in soil and could enter the groundwater.
3. Water – No information on the transformation/persistence of tartaric acid in water was found in the secondary sources searched. Being a strong organic acid (Budavari et al. 1996), it is expected to dissociate into its ion components when in water.
4. Biota – No information on the transformation/persistence of tartaric acid in the biota was found in the secondary sources searched. Its high water solubility indicates that it would not appreciably bioconcentrate in the flora or fauna.

## CHEMICAL SUMMARY FOR TETRASODIUM EDTA (Na<sub>4</sub>EDTA)

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of Na<sub>4</sub>EDTA are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF Na <sub>4</sub> EDTA		
Characteristic/Property	Data	Reference
CAS No.	64-02-8	
Common Synonyms	(ethylenedinitrilo)tetraacetic acid tetrasodium salt; edetate sodium; edetic acid tetrasodium salt; EDTA tetrasodium salt; Trilon B; Versene 100; Versene beads or flake	HSDB 1995
Molecular Formula	C <sub>10</sub> H <sub>16</sub> N <sub>2</sub> O <sub>8</sub> .4Na	HSDB 1995
Chemical Structure		
Physical State	white powder; anhydrous or 2H <sub>2</sub> O	HSDB 1995
Molecular Weight	380.20	HSDB 1995
Melting Point	not found	
Boiling Point	not found	
Water Solubility	103 g/100 mL; very soluble	HSDB 1995
Density	6.9 lb/gal	HSDB 1995
Vapor Density (air = 1)	not found	
K <sub>oc</sub>	not found	
Log K <sub>ow</sub>	not found	
Vapor Pressure	0.24 x 10 <sup>2</sup> torr @ 25°C	CHEMFATE 1995
Reactivity	reacts with most divalent and trivalent metallic ions to form soluble metal chelates	HSDB 1995
Flammability	not found	
Flash Point	not found	
Dissociation Constant	not found	
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	not found	
Conversion Factors	1 ppm = 16.7 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.064 ppm	Calculated using: ppm = mg/m <sup>3</sup> x 24.45/m.w.

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of Na<sub>4</sub>EDTA. The chemical is probably released to air, water, and soil from industries that manufacture and use it, from the use of pesticide formulations that contain it, and from the disposal of pharmaceuticals and other consumer products that contain it.

#### B. Transport

No information was found in the secondary sources searched regarding the environmental transport of Na<sub>4</sub>EDTA. The vapor pressure for Na<sub>4</sub>EDTA (0.24 x 10<sup>2</sup> torr [CHEMFATE 1995]) suggests that the chemical is moderately volatile and may undergo volatilization from soil and water surfaces. The high water solubility of Na<sub>4</sub>EDTA suggests possible leaching of the chemical through the soil to groundwater.



### C. Transformation/Persistence

1. Air — Estimated half-lives for the reaction of Na<sub>4</sub>EDTA with RO<sub>2</sub>, OH, and O<sub>3</sub> are 2200 years, 8 minutes, and 1 day, respectively (CHEMFATE 1995). This suggests that Na<sub>4</sub>EDTA in the atmosphere may undergo significant reaction with photochemically-generated hydroxyl radicals and ozone.
2. Soil — Na<sub>4</sub>EDTA released to the soil would form soluble metal chelates with most divalent and trivalent metallic ions (HSDB 1995).
3. Water — The reaction of Na<sub>4</sub>EDTA with OH in air (CHEMFATE 1995) suggests that the chemical may also react with photochemically-generated hydroxyl radicals in water.
4. Biota — No information was found in the secondary sources searched regarding the persistence or biomagnification of Na<sub>4</sub>EDTA in biota.

## CHEMICAL SUMMARY FOR TRIETHANOLAMINE

This chemical was identified by one or more suppliers as a bath ingredient for the electroless copper and tin-palladium processes. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of triethanolamine are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF TRIETHANOLAMINE		
Characteristic/Property	Data	Reference
CAS No.	102-71-6	
Common Synonyms	2,2',2''-nitrilotrisethanol	CHEMFATE 1995
Molecular Formula	$C_6H_{15}NO_3$	
Chemical Structure	$(HOCH_2CH_2)_3N$	
Physical State	pale yellow, viscous liquid	Benya and Harbison 1994
Molecular Weight	149.19	CHEMFATE 1995
Melting Point	21.57°C	CHEMFATE 1995
Boiling Point	335.4°C	CHEMFATE 1995
Water Solubility	miscible	CHEMFATE 1995
Density	$d^{20/4}$ , 1.1242	HSDB 1995
Vapor Density (air = 1)	5.1	HSDB 1995
$K_{oc}$	no data	
Log $K_{ow}$	-1.59	CHEMFATE 1995
Vapor Pressure	$3.59 \times 10^{-6}$ mm Hg at 25°C	CHEMFATE 1995
Reactivity	may become unstable at elevated temperatures and pressure	HSDB 1995
Flammability	must be heated before ignition will occur	HSDB 1995
Flash Point	190.5°C (open cup)	HSDB 1995
Dissociation Constant (pKa)	7.92	CHEMFATE 1995
Henry's Law Constant	$3.38 \times 10^{-19}$ atm-m <sup>3</sup> /mol (estimated)	CHEMFATE 1995
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	<1 (estimated)	
Odor Threshold	<3.9 (measured; species not given)	HSDB 1995
Conversion Factors	no data; slight ammoniacal odor	HSDB 1995
	1 ppm = 6.10 mg/m <sup>3</sup>	Calculated using the
	1 mg/m <sup>3</sup> = 0.164 ppm	formula: ppm =
		mg/m <sup>3</sup> (24.45/mol. wt)

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

No information was found in the secondary sources searched to indicate the specific amount of triethanolamine released to the environment in any given year. Approximately 100,000 - 500,000 tons/year of the chemical are produced worldwide (U.S. EPA 1995b). Although the production of triethanolamine is tightly controlled, a worst case estimation of production loss by industry to the environment is 0.5%. Release can also occur during the use of the chemical as a metal working/cutting fluid, as an additive to cement, as an intermediate in surfactant production, or in the manufacture of textile auxiliaries (U.S. EPA 1995b).

#### B. Transport

Because of the high water solubility and low octanol-water coefficient of triethanolamine, the chemical will likely partition into water. Although no data were found for the  $K_{ow}$ , adsorption onto soils is unlikely and leaching of the chemical into ground water is expected. The low vapor

pressure and low Henry's Law Constant indicate that volatilization to the atmosphere will be negligible.

### C. Transformation/Persistence

1. Air — The half-life for triethanolamine reaction with photochemically produced hydroxy radicals was estimated at 4 hours with a rate constant of  $10.4 \times 10^{-11}$  cm<sup>3</sup>/molecules-sec and assuming an average hydroxyl concentration of  $5 \times 10^5$  molecules/cm<sup>3</sup> (HSDB 1995). The chemical will also be removed from the atmosphere in precipitation (HSDB 1995).
2. Soil — Triethanolamine will be biodegraded rapidly in soils, following acclimation, with a half-life of days to weeks. Removal from soils also occurs through leaching (HSDB 1995).
3. Water — Triethanolamine is rapidly degraded in water following acclimation. In a batch system using activated sludge, the chemical was 89% degraded in 14 days following a 3 day acclimation period (CHEMFATE 1995). Other tests showed increases in theoretical biological oxygen demand (BODT) of 66% and 69% (sea water) in 20 days using sewage inoculum (CHEMFATE 1995; HSDB 1995).
4. Biota — Based on the low estimated bioconcentration factor and high water solubility of triethanolamine, the chemical is expected to have a low potential for bioaccumulation in aquatic organisms.

## CHEMICAL SUMMARY FOR SODIUM CITRATE

This chemical was identified by one or more suppliers as a bath ingredient for the organic-palladium process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

### I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of sodium citrate are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF SODIUM CITRATE		
Characteristic/Property	Data	Reference
CAS No.	68-04-2	
Common Synonyms	trisodium citrate; sodium citrate anhydrous; 2-hydroxy-1,2,3-propanetricarboxylic acid, trisodium salt	Lockheed Martin 1991
Molecular Formula	$C_6H_5Na_3O_7$	Budavari et al. 1989
Chemical Structure	$CH_2(COONa)C(OH)(COONa)CH_2COONa$	Osol 1980
Physical State	dihydrate, white crystals, granules, or powder; pentahydrate, relatively large, colorless crystals or white granules	Budavari et al. 1989
Molecular Weight	258.07	Budavari et al. 1989
Melting Point	150 °C (-2 H <sub>2</sub> O)	Fisher Scientific 1985
Boiling Point	decomposed at red heat	Lewis 1993
Water Solubility	72 g/100 mL at 25 °C (dihydrate)	Weast 1983-1984
Density	1.9	Fisher Scientific 1985
Vapor Density (air = 1)	no data	
K <sub>oc</sub>	no data	
Log K <sub>ow</sub>	no data	
Vapor Pressure	no data	
Reactivity	0 (nonreactive, NFPA classification); aqueous solution slightly acid to litmus	Lockheed Martin 1991 Osol 1980
Flammability	1 (slightly combustible, NFPA classification);	Lockheed Martin 1991
Flash Point	no data	
Dissociation Constant	no data	
Henry's Law Constant	no data	
Molecular Diffusivity Coefficient	no data	
Air Diffusivity Coefficient	no data	
Fish Bioconcentration Factor	no data	
Odor Threshold	no data; odorless	Lewis 1993
Conversion Factors	no data	

### II. ENVIRONMENTAL FATE

#### A. Environmental Release

Sodium citrate is a solid with a cool, saline taste that is soluble in water (Fisher Scientific 1985). It is used in soft drinks, frozen desserts, meat products, cheeses, and as a nutrient for cultured buttermilk; in photography; in detergents; as a sequestrant and buffer; as an anticoagulant for blood withdrawn from the body; and in the removal of sulfur dioxide from smelter waste gases (Lewis 1993). Medicinally, sodium citrate is used as expectorant and systemic alkalizer. Sodium citrate is a chelating agent and has been used to facilitate elimination of lead from the body (Osol 1980).

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No data were found on the environmental releases of sodium citrate. The chemical is not listed on U.S. EPA's TRI, requiring certain U.S. industries to report on chemical releases to the environment (TRI93 1995). The chemical could potentially enter the environment when used for the removal of sulfur dioxide from smelter waste gases.

### **B. Transport**

No data were found on the environmental transport of sodium citrate in the secondary sources searched. Its water solubility suggests that the sodium citrate would remain in the water phase.

### **C. Transformation/Persistence**

No data were found on the transformation/persistence of potassium bisulfate in the secondary sources searched.

## CHEMICAL SUMMARY FOR VANILLIN

This chemical was identified by one or more suppliers as a bath ingredient for the tin-palladium process. This summary is based on information retrieved from a systematic search limited to secondary sources (see Attachment C-1). The only exception is summaries of studies from unpublished TSCA submissions that may have been included. These sources include online databases, unpublished EPA information, government publications, review documents, and standard reference materials. No attempt has been made to verify information in these databases and secondary sources.

## I. CHEMICAL IDENTITY AND PHYSICAL/CHEMICAL PROPERTIES

The chemical identity and physical/chemical properties of vanillin are summarized below.

CHEMICAL IDENTITY AND CHEMICAL/PHYSICAL PROPERTIES OF VANILLIN		
Characteristic/Property	Data	Reference
CAS No.	121-33-5	
Common Synonyms	4-hydroxy-3-methoxybenzaldehyde; methyl-protocatechuic aldehyde; vanillic aldehyde; 3-methoxy-4-hydroxybenzaldehyde	Budavari et al. 1996
Molecular Formula	$C_8H_8O_3$	
Chemical Structure	$(CH_3O)C_6H_3(OH)CHO$	Kirwin and Galvin 1993
Physical State	white or slightly yellow needles	Budavari et al. 1996
Molecular Weight	152.15	Budavari et al. 1996
Melting Point	80-81 °C	Budavari et al. 1996
Boiling Point	285 °C	Budavari et al. 1996
Water Solubility	1 g/100 mL	Budavari et al. 1996
Density	1.056 g/mL	Budavari et al. 1996
Vapor Density (air = 1)	5.2	HSDB 1996
$K_{oc}$	not found	
Log $K_{ow}$	not found	
Vapor Pressure	$2.2 \times 10^{-3}$ mm Hg @ 25 °C	HSDB 1996
Reactivity	can react violently with bromine, potassium tert-butoxide, tert-chlorobenzene + NaOH, formic acid + $Tl(NO_3)_3$ and perchloric acid	Keith and Walters 1985
Flammability	not found	
Flash Point	not found	
Dissociation Constant	$pK_{a1}$ 7.40, $pK_{a2}$ 11.4 (25 °C)	Chapman and Hall 1995
Henry's Law Constant	not found	
Molecular Diffusivity Coefficient	not found	
Air Diffusivity Coefficient	not found	
Fish Bioconcentration Factor	not found	
Odor Threshold	$2 \times 10^{-1}$ ppm, water; $1.10 \times 10^{-8}$ ppb, air	Kirwin and Galvin 1993
Conversion Factors	1 ppm = 6.2 mg/m <sup>3</sup> 1 mg/m <sup>3</sup> = 0.161 ppm	Brabec 1993

## II. ENVIRONMENTAL FATE

## A. Environmental Release

No information was found in the secondary sources searched regarding the environmental release of vanillin. The chemical occurs naturally in vanilla, potato parings, and Siam benzoin (Budavari et al. 1996).

## B. Transport

No information was found in the secondary sources searched regarding the environmental transport of vanillin. The vapor pressure ( $2.2 \times 10^{-3}$  mm Hg [HSDB 1996]) for the chemical indicates that little volatilization from soil or water could occur. Vanillin is soluble in water (1 g/100 mL [Budavari et al. 1996]) and may move through the soil, possibly to groundwater.

### C. Transformation/Persistence

1. Air — Vanillin oxidizes to some extent when exposed to moist air and is "affected" by light (Budavari et al. 1996). Vanillin absorbs UV light at wavelengths of 308 and 278 nm (Kirwin and Galvin 1993), suggesting that phototransformation is possible. Decomposition of vanillin under strict anaerobic conditions has been observed (HSDB 1996).
2. Soil — No information was found in the secondary sources searched regarding the fate of vanillin in soil.
3. Water — No information was found in the secondary sources searched regarding the fate of vanillin in the aquatic environment. Based on its absorption of UV light at wavelengths of 308 and 278 nm, vanillin in surface water could undergo some phototransformation.
4. Biota — No information was found in the secondary sources searched regarding the bioaccumulation of vanillin.

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